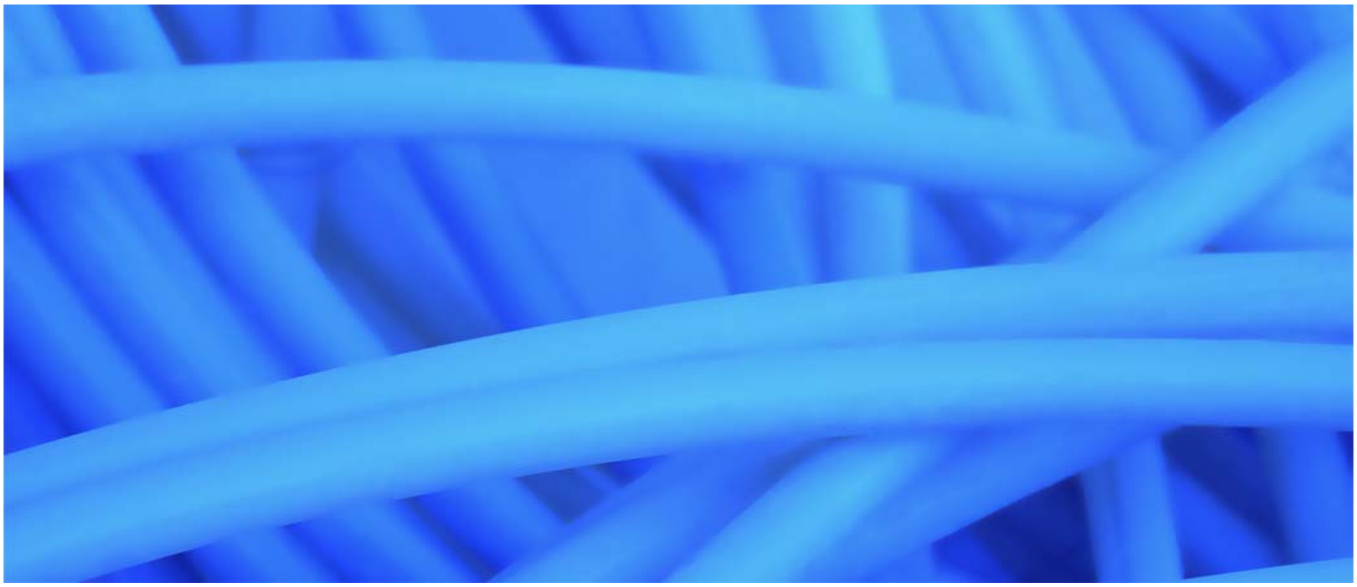
Draft Environmental Impact Report

# Adoption of Statewide Regulations Allowing the Use of PEX Tubing



Prepared by:

EDAW
2022 J Street
Sacramento, CA 95814

May 2008

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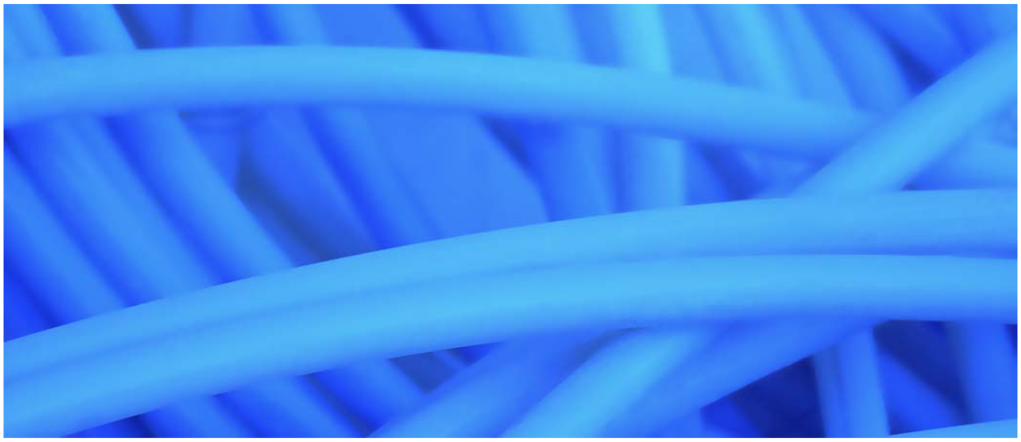

Prepared for:

California Building Standards Commission
2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833

Attn: Valerie Namba
Department of General Services
Senior Environmental Planner
916/376-1607

Prepared by:

EDAW
2022 J Street
Sacramento, CA 95811

Contact:

Heather Halsey
Project Manager
916/414-5800

May 2008

EDAW | AECOM

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**EXHIBITS**



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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AB | assembly bill |
| AB 1807 | Tanner Air Toxics Act - Statutes of 1983 |
| AB 2588 | Air Toxics Hot Spots Information and Assessment Act of 1987-Statutes of 1987 |
| ANSI | American National Standards Institute |
| aqua TAC | total allowable concentration |
| ARB | California Air Resources Board |
| ASTM | American Society for Testing Materials |
| ATCM | airborne toxics control measure |
| BACT | best available control technology for toxics |
| BSC | California Building Standards Commission |
| CAA | federal Clean Air Act |
| CAAA | federal Clean Air Act Amendments |
| CAAQS | California ambient air quality standards |
| Cal/OSHA | California Occupational Safety and Health Assessment Program |
| CBC | California Building Code |
| CBSC | California Building Standards Code |
| CCAA | California Clean Air Act |
| CCR | California Code of Regulations |
| CEQA | California Environmental Quality Act |
| CIWMA | California Integrated Waste Management Act |
| CIWMB | California Integrated Waste Management Board |
| CO | carbon monoxide |
| $CO^2$ | carbon dioxide |
| CPC | California Plumbing Code |
| CPVC | chlorinated polyvinyl chloride |
| dbps | disinfection by-products |
| DEIR | draft environmental impact report |
| DFA | Department of Food and Agriculture |
| DHS | Department of Health Services |
| diesel PM | diesel particulate matter |
| DPH | Department of Public Health |
| DSA | Division of the State Architect |
| DWSAP | Drinking Water Source and Assessment Program |
| EIR | environmental impact report |

| | |
|---|---|
| EPA | U.S. Environmental Protection Agency |
| ETBE | ethyl-t-butyl ether |
| F rating | standards related to fire retardation |
| GHG | greenhouse gas |
| HAA | haloacetic acids |
| HAA5 | total haloacetic acids |
| HAP | hazardous air pollutant |
| HCD | California Department of Housing and Community Development |
| HDPE | high-density polyethylene |
| IAPMO | International Association of Plumbing and Mechanical Officials |
| LCR | Lead and Copper Rule |
| MAC | maximum acceptable concentration |
| MACT | maximum available control technology for toxics |
| MCL | maximum contaminant levels |
| mg/L | milligrams per liter |
| MIBK | 4-methyl-2-pentanone |
| MTBE | methyl tertiary-butyl ether |
| mV | millivolt |
| NAAQS | national ambient air quality standard |
| NESHAP | national emissions standards for hazardous air pollutants |
| $NO^2$ | nitrogen dioxide |
| NOC | Notice of Completion |
| NOP | Notice of Preparation |
| $NO_X$ | oxides of nitrogen |
| NSF | NSF International, Inc. |
| OEHHA | Office of Environmental Health Hazard Assessment |
| OHB | Occupational Health Branch of California Department of Health Services |
| ORP | oxidative reduction potential |
| OSHA | federal Occupational Safety and Health Administration |
| OSHA | Occupational Safety and Health Administration |
| OSHPD | Office of Statewide Health Planning and Development |
| PB | polybutylene |
| PE | polyethylene |
| PET | polyethylene terephthalate |
| PEX | cross-linked polyethylene |
| PEX-AL-PEX | cross linked polyethylene with an aluminum layer |

| | |
|---|---|
| PHG | public health goal |
| $PM^{10}$ | respirable particulate matter |
| $PM^{2.5}$ | fine particulate matter |
| PP | polypropylene |
| ppb | parts per billion |
| PPFA | Plastic Pipe and Fittings Association |
| ppm | parts per billion |
| psi | pounds per square inch |
| PVC | polyvinyl chloride |
| ROG | reactive organic gases |
| SB | senate bill |
| $SO_2$ | sulfur dioxide |
| SPAC | single product allowable concentration |
| STEL | short-term exposure level |
| T rating | standards related to temperature retardation |
| TAC | toxic air contaminant |
| TBA | tertiary butyl alcohol |
| T-BACT | best available control technology for toxic air contaminants |
| TCE | trichloroethylene |
| THM | trihalomethanes |
| TMDL | total maximum daily load |
| TOE | threshold of evaluation |
| TPY | tons per year |
| TTHM | trihalomethanes |
| UBC | Uniform Building Code |
| UPC | Uniform Plumbing Code |
| UV | ultraviolet |
| VOC | volatile organic compound |
| µg/L | micrograms per liter |
| $\mu g/m^3$ | micrograms per cubic meter |

# 1 EXECUTIVE SUMMARY

## 1.1 SUMMARY DESCRIPTION OF THE PROPOSED ACTION

The California Building Standards Commission (BSC) proposes to adopt new state plumbing code regulations that would remove the prohibition against the use of cross-linked polyethylene (PEX) tubing, a type of plastic pipe, for potable water uses from the California Plumbing Code. The tubing would be authorized for use in various cold and hot water (including potable water) plumbing applications in residential, commercial, and institutional buildings. This proposed adoption would be an activity undertaken by a public agency and has the potential to result in direct or indirect physical changes in the environment. As such, it constitutes a "project" under the California Environmental Quality Act (CEQA) (Public Resources Code Section 21065).

BSC proposes adoption of state plumbing code regulations that would authorize the statewide use of PEX tubing for various cold and hot water (including potable water) plumbing applications in residential, commercial, and institutional buildings. Responsible Agencies, each of which will rely on this EIR for adoption of its own regulations, will be the Department of Housing and Community Development (HCD), Division of the State Architect (DSA), Office of Statewide Health Planning and Development (OSHPD), Department of Public Health (DPH) (previously known as DHS), and the Department of Food and Agriculture (DFA). Cities and counties would not be responsible agencies because they would not have any authority to approve the project or to disapprove or add requirements or restrictions relating to the use of PEX within their jurisdictions after it is approved by BSC, unless they make express findings for such additions or deletions based on climatic, topographical, or geological conditions (CPC 101.8.1). BSC's objective in proposing these regulations is to provide an alternative plastic hot and cold water plumbing material for use in California. The proposed adoption of regulations related to PEX tubing is a statewide regulatory change. As such, the project area is the State of California.

The proposed project is the adoption of regulations (i.e., building standards) pertaining to the use of PEX tubing. Implementation of the proposed project would allow the statewide use of PEX tubing for hot and cold water (including potable water) distribution for applications under the jurisdiction of the Responsible Agencies that adopt regulations based on environmental information and conclusions in this EIR. This includes applications such as drinking water, irrigation, and wastewater. The proposed PEX tubing regulations would apply to all occupancies, including commercial, residential, and institutional building construction, rehabilitation, and repair under the jurisdiction of BSC and the Responsible Agencies in all areas of the state. Examples of commercial occupancies include retail establishments, restaurants, office buildings, salons, theaters, farms, ranches, and food processing plants. Residential buildings include, but are not limited to, single-family dwellings, apartment houses, hotels, motels, lodging houses, dwellings, dormitories, condominiums, shelters for homeless persons, congregate residences, employee housing, factory-build housing, permanent buildings and permanent accessory buildings or structures constructed within manufactured home parks and special occupancy parks, and other types of dwellings containing sleeping accommodations with or without common toilet or cooking facilities including accessory buildings and facilities. Institutional building examples include schools and hospitals.

In this EIR, the terms "PEX tubing" and "PEX" refer to cross-linked polyethylene (PE) tubing also known as PEX tubing unless the context clearly indicates otherwise. These regulations, if approved, would become part of the CPC, which is a part of the California Building Standards Code. BSC is responsible for the final approval and adoption of the California Building Standards Code. BSC receives proposed code revisions from a number of public agencies that have statutory authority to propose codes for various types of occupancies. The Responsible Agencies for this project have regulatory authority over the commercial, residential, and institutional occupancies to which the proposed regulations would apply.

## 1.2 ENVIRONMENTAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Table 1-1, located at the end of this chapter, provides a summary of the environmental impacts of the project, level of significance before mitigation, recommended mitigation measures, and the level of significance after the application of mitigation measures.

## 1.3 SUMMARY OF CUMULATIVE IMPACTS

The analysis of cumulative environmental impacts associated with the project addresses the potential incremental impacts of the project in combination with those of other past, present, and probable future projects. For the purposes of this analysis, the chlorinated polyvinyl chloride (CPVC) plastic plumbing pipe project is a related past project.

The Adoption of Regulations Permitting Statewide Residential Use of CPVC Plastic Plumbing Pipe project is the adoption of regulations (i.e., building standards) pertaining to the use of CPVC pipe for potable water plumbing applications in a variety of structures including hotels, motels, apartment houses, condominiums, and shelters for homeless persons. The lead agency for the CPVC project was HCD. The regulations were recently approved, and became effective January 1, 2008, and are now part of the California Plumbing Code (CPC) (HCD 2006:11).

The analysis of cumulative environmental impacts associated with the project also addresses the potential incremental impacts of the project in combination with those of past environmental impacts. For the purposes of this analysis, the presence of methyl tertiary butyl ether (MTBE) or tertiary butyl alcohol (TBA) in drinking water sources is considered a past environmental impact.

MTBE has been detected in a number of drinking water sources in California at levels greater than MTBE's California primary MCL of 0.013 mg/L and secondary MCL of 0.005 mg/L. In addition, MTBE has been detected in drinking water sources at levels less than 0.005 mg/L (California Department of Public Health 2006). As described in Impact 4.4-1 (see Section 4.4, "Water Quality"), testing indicates that a proportion of PEX tubing has been associated with leaching levels of MTBE and TBA at levels exceeding the California primary and secondary MCLs for MTBE and exceeding the California notification and response levels for TBA.

A discussion of potential cumulative impacts associated with the project is provided in Chapter 5. For most impacts, the project's contribution to cumulative impacts would not be considerable with the exception of the following:

### Water Quality

The use of PEX tubing for human consumption uses has the potential to contribute to drinking water contamination from MTBE or TBA when used in combination with certain environmental conditions. This impact has the greatest potential to occur where the source water (either well water or water from a public water provider) also contains those contaminants. In that case, depending on the situation, the water served by a public water provider or a well, for example, could contain a level of a contaminant, such as MTBE, that does not exceed the MCL. However, combined with the MTBE from PEX, also below the California MCL for MTBE, the MCL could be exceeded, even though the contribution from PEX is individually insignificant. Therefore, the cumulative impact on drinking water from chemicals leaching from PEX in combination with certain environmental conditions would be significant, and the project's contribution would be potentially cumulatively considerable.

## 1.4 AREAS OF CONTROVERSY

Section 15123 of the State of California Environmental Quality Act (CEQA) Guidelines requires the summary section of an EIR to include “areas of controversy known to the lead agency.” The following issues, in no order of importance, are the controversial issues known to BSC:

- PEX tubing may degrade prematurely and rupture due to exposure to numerous commonly encountered materials and environmental conditions. This could cause water damage to homes and could potentially result in black mold.

- Comments have been made that PEX tubing may be flammable or may increase the spread of fire.

- When incinerated, PEX tubing may release toxic air contaminants.

- PEX tubing may promote the growth of biofilms containing dangerous microbes such as Legionella.

- Chemicals such as MTBE, TBA, and other aromatic hydrocarbons may leach directly out of PEX tubing and contaminate drinking water at levels that exceed California standards.

- Concerns have been expressed that pesticides, termiticides, benzene, gasoline constituents, and other toxic chemicals may permeate PEX tubing and enter drinking water.

## 1.5 SUMMARY OF ALTERNATIVES

### 1.5.1 ALTERNATIVE A: NO PROJECT ALTERNATIVE

The proposed project would adopt new state plumbing code regulations that would remove the prohibition against the statewide use of PEX tubing in various cold and hot water plumbing (including potable water) applications in residential, commercial, and institutional buildings. As discussed in Chapter 3, “Description of the Proposed Project,” PEX is widely used throughout California for hydronic radiant heat flooring and is authorized for all uses in manufactured homes. Three cities have adopted ordinances allowing unrestricted PEX use and nearly 200 California cities and nearly 30 California counties have approved the use of PEX as an alternate material. The No Project Alternative is defined as the current pipe usage in California plus the reasonably foreseeable future pipe usage for approved plumbing materials if the regulation is not adopted and the prohibition against the use of PEX for hot and cold water distribution (including potable water uses) is not removed.

The 2005 California market shares for piping materials for new single-family homes were approximately 29% PEX, 13% CPVC, 54% copper, and 4% for all other materials. More recent data on PEX indicate that it now constitutes 37% of the California market for piping materials for new single-family homes. Assuming that the proposed regulation is not adopted, the market share for PEX could remain at about 37% for new single-family homes. The November 2006 recirculated DEIR for the Adoption of Regulations Permitting the Statewide Residential Use of CPVC (HCD 2006:45) projected that with the adoption of that regulation, the market share for CPVC for new single-family homes would increase to approximately 30%, which is equal to the percent of the nationwide market share for CPVC. Therefore, a likely distribution of market share in California for new single-family homes under a No Project scenario could eventually comprise approximately 30% CPVC, 37% PEX, 29% copper, and 4% all other materials.

With or without the proposed project, it is anticipated that the market share for copper in California will continue to decline and the proportion of plastic pipe use will continue to grow proportionately. This is due in part to recent changes to federal drinking water standards to reduce exposures to disinfection by-products (dbps), specifically trihalomethanes, which are known carcinogens and reproductive toxicants which may pose a problem particularly when surface water is a source of water for human consumption. The most economical way for public water agencies to meet the new federal standards to reduce exposure to dbps is to switch from chlorine to chloramines for disinfection of water supplies (EPA 2007a). That switch has been a recent trend in California (EPA 2007b). As discussed in Section 4.2, "Public Health and Hazards," and Section 4.4, "Water Quality," chloramines have a corrosive effect on copper tubing. This fact, combined with the lower costs for materials and labor related to the use of plastic piping materials, means that it is likely that the plastic tubing market in California will continue to grow, even under the No Project Alternative. If use of PEX in California were to decline under the No Project Alternative, it is likely that the result would be an increase in the use of CPVC rather than an increase in the use of copper for the reasons discussed above.

### 1.5.2 ALTERNATIVE B: MITIGATED ALTERNATIVE

Alternative B would provide another plastic hot and cold water plumbing material for use in California. Under Alternative B, all PEX used in California for human consumption purposes would be certified by NSF to meet the relevant primary and secondary MCL, notification, Proposition 65 Safe Harbor, or other applicable Proposition 65 levels for drinking water. Alternative B would also require that PEX only be used above the slab unless a Phase 1 Environmental Site Assessment for the project is conducted following the ASTM E 1527-05 standard, which concludes that contamination of the soils or groundwater in the project area is unlikely, or unless the PEX is sleeved by a metal pipe or other proven impermeable barrier. Finally, for all continuously recirculating hot water systems in jurisdictions where chlorination is used for disinfection of water, PEX tubing must be certified using the NSF P171-CL-R standard or a yet-to-be-adopted comparable standard.

### 1.5.3 CONSIDERATION OF THE ENVIRONMENTALLY SUPERIOR ALTERNATIVE

The No Project Alternative would be environmentally superior to the proposed project with respect to public health and hazards, leaching of chemical compounds into drinking water and indoor air quality. It would be similar to the project with respect to solid waste, and would result in greater environmental impacts in outdoor air quality (ROGs) and leaching of copper into drinking water and wastewater. Overall, this alternative is environmentally superior to the proposed project. This alternative would not attain the project's objective of providing an alternative plastic hot and cold water plumbing material for use in California.

Alternative B would be environmentally superior to the project with respect to public health and hazards, water quality and air quality. It would be similar to the project with respect to solid waste. Overall, this alternative is environmentally superior to the proposed project. The overall objective of the proposed project is to provide another plastic piping alternative for use in California. Alternative B would authorize the use of an additional type of plastic pipe in California, and thus would attain the project objective.

Alternative B: Mitigated Alternative is the overall environmentally superior alternative of all the alternatives evaluated.

**Table 1-1**
**Summary of Project Impacts and Mitigation Measures**

| Impacts | Significance Before Mitigation | Mitigation Measures | Significance After Mitigation |
|---|---|---|---|
| **4.1 Air Quality** | | | |
| **4.1-1: Air Quality—Exposure of Sensitive Receptors to Toxic Air Contaminants.** Because manufacture of PEX tubing occurs out of state and is subject to EPA and local air quality rules and regulations, and installation does not require use of adhesives or solvents, neither the manufacture nor installation of PEX tubing would result in an increased risk of exposure of sensitive receptors to TAC emissions. Therefore, this impact is less than significant. | LTS | No mitigation measures are necessary because the impact is less than significant. | LTS |
| **4.1-2: Air Quality—Exposure of Sensitive Receptors to Biological Agents Including Mold.** PEX tubing failure and flooding could result in the buildup of moisture in structures and the growth and spread of biological agents including mold. Because PEX tubing could prematurely fail and could lead to moisture buildup in structures, exposing sensitive receptors to mold, this impact is potentially significant. | PS | **4.1-2: Exposure of Sensitive Receptors to Biological Agents Including Mold.** The California Building Standards Commission shall implement Mitigation Measure 4.2-3, as described in Section 4.2, “Public Health and Hazards,” to avoid the potential for a significant increase exposure of sensitive receptors to mold. Implementation of this mitigation measure would reduce this impact to a less than significant level. | LTS |
| **4.1-3: Air Quality—Exposure of the Public or Emergency Personnel to Toxic Products of Combustion from PEX Incineration.** Incineration of PEX tubing would not increase health risks to the public or emergency personnel because other plastics and materials in buildings, including materials and products made from wood and other organic fibers, also produce toxic products of combustion hazardous to the health of humans, and the quantity of PEX tubing is relatively insignificant when compared to all the other materials within a building. Gases emitted from plastic tubing are no more toxic than other common building and furnishing materials found in structures. In addition, structure fire would be considered an anomaly and not part of the baseline under CEQA. Therefore, this impact is less than significant. | LTS | No mitigation measures are necessary because the impact is less than significant. | LTS |

NI = No Impact    LTS = Less than Significant    S = Significant    PS = Potentially Significant    SU = Significant and Unavoidable

**Table 1-1**
**Summary of Project Impacts and Mitigation Measures**

| Impacts | Significance Before Mitigation | Mitigation Measures | Significance After Mitigation |
|---|---|---|---|
| **4.2 Public Health** | | | |
| **4.2-1: Public Health and Hazards—Potential Risk of Contact with Pathogens from Biofilm Growth.** Because biofilm could potentially harbor pathogenic bacteria such as Legionella, higher amounts of biofilm could lead to increased risk of human contact with pathogenic bacteria. All piping materials exhibit some biofilm formation (Chaudhuri, pers. comm., 2008). Although formation of biofilm is initially slower in copper tubing compared to PEX tubing, no substantial difference exists over longer periods. No direct quantitative correlation exists between measurements of biofilm and growth of Legionella. Therefore, increased biofilm growth does not correspond to higher amounts of Legionella bacteria, and the use of PEX would not lead to increased risk of human contact with pathogenic bacteria. Therefore, this is considered a less-than-significant impact. | LTS | No mitigation measures are necessary because the impact is less than significant. | LTS |
| **4.2-2: Public Health and Hazards—Increased Risk of Fire Ignition and Fire Spread.** PEX tubing carrying water within a building is not likely to be flammable. Conformance to CPC requirements and applicable design and installation guidelines, including the use of approved firestop material, would reduce any potential fire hazards–related depressurization of plastic tubing during structural fires. Additionally, plastic tubing is not an efficient heat conductor and structure fires generally do not exceed the temperature necessary to cause plastic tubing to ignite, thus the use of PEX would not increase fire hazards. Therefore, this impact is less than significant. | LTS | No mitigation measures are necessary because the impact is less than significant. | LTS |
| **4.2-3: Public Health and Hazards—Risk of Premature or Unexpected PEX Failure and Flooding Potentially Increasing the Incidence of Mold.** UV light, certain firestop materials, and chlorine can contribute to failure of PEX. However, PEX manufacturers add UV resistant material into the pipe and include instructions to avoid UV degradation, which decreases the impact of UV light on PEX. Numerous | PS | **4.2-1: Risk of Premature or Unexpected PEX Failure and Flooding Potentially Increasing the Incidence of Mold.** The Building Standards Commission will adopt regulatory language requiring that when installing PEX for recirculating systems in jurisdictions that use chlorine for disinfection, the PEX tubing must be certified using the NSF P171 CL-R standard or a yet-to-be adopted equally rigorous standard that assumes 100% | LTS |

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**Table 1-1**
**Summary of Project Impacts and Mitigation Measures**

| Impacts | Significance Before Mitigation | Mitigation Measures | Significance After Mitigation |
|---|---|---|---|
| firestop materials are compatible with PEX and appropriately used firestop materials do not degrade PEX. Finally, the possibility of PEX failure from chlorine degradation would be confined to jurisdictions that have not yet switched to chloramine disinfection and specifically to projects in those jurisdictions that use continuously recirculating, hot, chlorinated water systems. Without attack from chloramines, aggressive water, or soils, copper pipes are known to outlast the buildings in which they are installed. However, no data are available that show the actual life expectancy of CPVC and PEX; data from the NSF and ASTM testing methods estimate life expectancy, but are based on extrapolation. Extrapolation means to project, extend, or expand known data or experience into an area not known or experienced to arrive at a usually conjectural knowledge of the unknown area. In other words, extrapolation means to predict by projecting past experience or known data: in this case, predicting the time to failure under extremely harsh conditions. Though extrapolation can provide reasonably reliable predictions, some measure of uncertainly is involved. Because the ASTM standard—unlike the NSF standard—simply does not assume that some systems will operate with continuously recirculating hot chlorinated water or incorporate a design factor, the level of certainty provided by ASTM F2023 is not as great as that provided by NSF P171. Because PEX tubing within jurisdictions that use chlorine and continuously recirculating, hot, chlorinated water systems may have shorter product lives than copper, CPVC, or PEX in traditional domestic applications and this consideration is not accounted for in the current ASTM F2023, this is considered a potentially significant impact. | | continuously recirculating chlorinated hot water, would ensure a conservative product lifetime of 40 years and is approved by the Building Standards Commission for testing PEX for continuously recirculating hot chlorinated water. Because the NSF P171 CL-R standard assumes 100% hot water and includes a safety factor to ensure a conservative product lifetime of 40 years, this would reduce the risk of premature or unexpected PEX failure to less than significant. | |
| **4.2-4: Public Health and Hazards—Increased Safety Hazards for Plumbers.** PEX tubing does not require the use of solvents, glues, or open flames during installation. Also, PEX tubing is lighter than metal pipes. Therefore, there are no health hazards for plumbers and this impact is less than significant. | LTS | No mitigation measures are necessary because the impact is less than significant. | LTS |

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**Table 1-1**
**Summary of Project Impacts and Mitigation Measures**

| Impacts | Significance Before Mitigation | Mitigation Measures | Significance After Mitigation |
|---|---|---|---|
| **4.3 Solid Waste** | | | |
| **4.3-1: Solid Waste—Increased Generation of Solid Waste.** Although the proposed project would slightly increase the amount of scrap PEX generated for disposal (i.e., up to 0.03 % of the total solid waste annually sent to landfills statewide), the maximum amount of solid waste annually generated by the proposed project is not substantial in relation to the total amount of landfilled solid waste. In addition, PEX tubing could be diverted and sold for other uses, and there is no substantial evidence that the addition of PEX waste, in and of itself, would be sufficient to substantially consume landfill capacity or otherwise shorten the planned disposal life of any landfill. Therefore, this impact is considered less than significant. | LTS | No mitigation measures are necessary because the impact is less than significant. | LTS |
| **4.3-2: Solid Waste—California Integrated Waste Management Act Compliance**. In 2005, California achieved a 52% waste diversion rate and increased the diversion rate to 54% in 2006. Assuming these trends continue into the future, California will continue to meet the 50% waste diversion rate as required by the CIWMA. Because the state of California is currently meeting the CIWMA diversion rate goal, the statewide diversion rate trend is upward, and implementation of the proposed project would not indirectly violate or cause noncompliance with the CIWMA, this impact is considered less than significant. | LTS | No mitigation measures are necessary because the impact is less than significant. | LTS |
| **4.4 Water Quality** | | | |
| **4.4-1: Water Quality—Noncompliance with Drinking Water Standards Resulting from Leaching.** The project would increase the use of PEX tubing in California. Because testing indicates that a proportion of PEX tubing has been associated with leaching levels of MTBE and tertiary butyl alcohol (TBA) at levels exceeding the California primary and secondary MCLs for MTBE and exceeding the California notification and response levels for TBA, and because PEX has the potential to | PS | **4.4-1: Noncompliance with Drinking Water Standards Resulting from Leaching.**<br>NSF certifies that each formulation of PEX tubing for potable water with the marking “NSF ®-pw” has met the NSF 61 standards for drinking water. Every PEX formulation from each manufacturer is tested before certification. Before using PEX for human consumption uses, PEX must receive NSF certification that any leached concentrations of MTBE, TBA, or Proposition | LTS |

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**Table 1-1**
**Summary of Project Impacts and Mitigation Measures**

| Impacts | Significance Before Mitigation | Mitigation Measures | Significance After Mitigation |
|---|---|---|---|
| leach Proposition 65 chemicals in concentrations higher than allowed under the Proposition 65 statute and its implementing regulations, this impact is potentially significant. | | 65 chemicals is below the relevant MCL, notification, or Safe Harbor level or other applicable Proposition 65 level for those chemicals. The Building Standards Commission shall require that PEX installed in California for water for human consumption be physically marked in a manner that indicates that the pipe is certified for California human consumption water uses and meets all California drinking water criteria under the California Safe Drinking Water Act and Proposition 65.<br>Adoption of Mitigation Measure 4.4.1 would reduce potential impacts relative to leaching of MTBE, TBA, or Proposition 65 chemicals to less than significant levels. | |
| **4.4-2: Water Quality—Adverse Taste and Odor Impacts.** The proposed project would result in the increased use of PEX tubing in California, 25.4% of which exceeds the secondary MCL for MTBE for taste and odor set by DPH. Thus, a substantial number of people would be affected by unpleasant tastes and odors in drinking water on a frequent basis. This is a significant impact. | S | **4.4-2: Adverse Taste and Odor Impacts.**<br>Before using PEX for human consumption water uses, PEX must receive NSF certification that any leached concentrations of MTBE is below the secondary California MCL for this chemical. PEX manufacturers claim that MBTE and TBA levels leached from PEX decline over time. They may pursue testing by NSF to determine whether the levels decline to below California criteria within a limited time.<br>Adoption of Mitigation Measure 4.4.2 would reduce taste and odor impacts on drinking water from leaching MTBE to less than significant. | LTS |
| **4.4-3: Water Quality—Noncompliance with Drinking Water Standards Resulting from Permeation.** In cases where PEX is placed below the slab where contaminated soils are present and permeated by solvents or gasoline, it has the potential to introduce chemicals into drinking water at levels in exceedance of federal and California MCLs, notification and response levels, or the Proposition 65 Safe Harbor levels, as well as to introduce Proposition 65 chemicals for which there are no adopted federal or California standards. Because the project would allow the use of PEX for hot and cold water distribution including potable water uses and the proposed regulations provide no restriction on uses below the slab this project could | PS | **4.4-3: Noncompliance with California and Federal Drinking Water Standards (including Proposition 65) Resulting from Permeation.**<br>The regulation shall require the installation of PEX for potable water uses above the slab unless:<br>► a Phase 1 Environmental Site Assessment is conducted following the ASTM E1527-05 standard, for every project that would use PEX below the slab, which concludes that contamination of the soils or groundwater in areas where PEX tubing would be placed or could be reasonably permeated by nearby contamination with solvents or gasoline is unlikely; or, | LTS |

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**Table 1-1**
**Summary of Project Impacts and Mitigation Measures**

| Impacts | Significance Before Mitigation | Mitigation Measures | Significance After Mitigation |
|---|---|---|---|
| result in a potentially significant impact. | | ► The PEX is sleeved by a metal or other material that is impermeable to solvents and petroleum products.<br>A "project" subject to the Phase I assessment requirement could be anything from a single housing unit to a project of several thousand units of housing. So for a project of one unit or of multiple units, only one Phase I assessment would be required for the entire project. A Phase I Environmental Site Assessment, often referred to as "environmental due diligence," is used by purchasers and lenders to evaluate a property for potential environmental contamination and to assess the potential liability for contamination present at the property. Compliance with ASTM E1527-05 standards would include:<br>► review of federal, state, and local environmental databases;<br>► interviews with local environmental oversight agencies and interviews with property owners and/or other interested party(ies);<br>► review of historical building permits, historical insurance (Sanborn) maps, historical city directories, historical topographic maps, and historical aerial photographs;<br>► inspection of subject property and surrounding areas;<br>► research of public agency records pertaining to historical land use (e.g., GeoTracker database); and<br>► conclusions regarding the presence or potential presence of environmental liabilities at the subject property.<br>► The conclusions will include a determination regarding the likelihood of the presence of solvents or gasoline in soils on the property. This will provide adequate assurance that the property is not contaminated with solvents or gasoline.<br>Adoption of Mitigation Measure 4.4-3 would ensure that potential impacts on compliance with Drinking Water Standards resulting from permeation are reduced to less than significant. | |

NI = No Impact LTS = Less than Significant S = Significant PS = Potentially Significant SU = Significant and Unavoidable

**Table 1-1**
**Summary of Project Impacts and Mitigation Measures**

| Impacts | Significance Before Mitigation | Mitigation Measures | Significance After Mitigation |
|---|---|---|---|
| **CUMULATIVE IMPACTS** | | | |
| **Air Quality** | | | |
| **Criteria Air Pollutant and TAC Emissions**<br>Because the proposed project would not emit any criteria air pollutants and would not result in an increased risk of exposure of sensitive receptors to TAC emissions, cumulative impacts would be **less than significant**, and the proposed project's contribution would not be cumulatively considerable. | LTS Cumulative Impact | No mitigation measures are necessary because the cumulative impact is less than significant. | Not Cumulatively Considerable |
| **PEX and CPVC Incineration**<br>The impacts associated with TAC emissions from incineration of plastic plumbing materials (including PEX and CPVC) as a result of a structure fire would be **less than significant**, and the project's contribution would not be considerable. | LTS Cumulative Impact | No mitigation measures are necessary because the cumulative impact is less than significant. | Not Cumulatively Considerable |
| **Climate Change**<br>The proposed project would result in a reduction in GHG emissions associated with pipe production as compared with the existing condition, which was estimated to result in substantially higher GHGs emissions over the life cycle. Increased CPVC market share would also result in a reduction in GHG emissions associated with pipe production as compared to the existing condition. The proposed project would not result in a substantial increase in GHG emissions relative to existing conditions, and would not result in a cumulatively considerable contribution to the impact of global climate change, and this impact would be **less than significant**. | LTS Cumulative Impact | No mitigation measures are necessary because the cumulative impact is less than significant. | Not Cumulatively Considerable |
| **Public Health and Hazards** | | | |
| **Biofilm, Fire Ignition Spread Risk, and Worker Safety Hazard Impacts**<br>Because the project's biofilm, fire spread risk, and safety hazard impacts would be less than significant, no mitigation measures are required and no significant public health or | LTS Cumulative Impact | No mitigation measures are necessary because the cumulative impact is less than significant. | Not Cumulatively Considerable |

NI = No Impact LTS = Less than Significant S = Significant PS = Potentially Significant SU = Significant and Unavoidable

**Table 1-1**
**Summary of Project Impacts and Mitigation Measures**

| Impacts | Significance Before Mitigation | Mitigation Measures | Significance After Mitigation |
|---|---|---|---|
| hazards impacts would occur. Because the CPVC project would also conform to applicable CPC requirements and design and installation guidelines, and because safety hazards associated with the CPVC project are less than significant (HCD 2006:ES), these impacts would be considered **less than significant** both on an individual project and cumulative basis, and the project's contribution would not be considerable. | | | |
| **Premature PEX Failure, Flooding and Potential Mold Impacts**<br>Implementation of the project with the proposed mitigation would not create increased risk of premature PEX failure and would not result in any cumulatively considerable incremental contributions to any significant cumulative impacts. This would be a **less-than-significant** cumulative public health and hazard impact, and the project's contribution would not be considerable. | LTS Cumulative Impact | No mitigation measures are necessary because the cumulative impact is less than significant. | Not Cumulatively Considerable |
| **Solid Waste** | | | |
| Although implementation of the proposed project, in combination with increased CPVC plastic tubing debris, would be expected to increase the volume of plastic debris requiring disposal, because the amount of PEX and CPVC solid waste generated annually would not be substantial in relation to the total amount of landfilled solid waste, this would be a **less-than-significant** cumulative impact, and the project's contribution would not be cumulatively considerable | LTS Cumulative Impact | No mitigation measures are necessary because the cumulative impact is less than significant. | Not Cumulatively Considerable |
| **Water Quality** | | | |
| **Leaching Impacts**<br>Because the proposed project and the CPVC project must meet applicable testing standards for leachates, this would be a **less-than-significant** cumulative water quality impact, and the project's contribution would not be considerable. | LTS Cumulative Impact | No mitigation measures are necessary because the cumulative impact is less than significant. | Not Cumulatively Considerable |

NI = No Impact LTS = Less than Significant S = Significant PS = Potentially Significant SU = Significant and Unavoidable

**Table 1-1**
**Summary of Project Impacts and Mitigation Measures**

| Impacts | Significance Before Mitigation | Mitigation Measures | Significance After Mitigation |
|---|---|---|---|
| **Permeation Impacts**<br>Because permeation impacts are not associated with CPVC piping, additive effects would not result from the combination of the CPVC project and the proposed project. Additionally, the potentially significant impact of permeation would be mitigated to a less-than-significant level by prohibiting the installation of PEX for potable water uses below the slab unless a Phase I Environmental Site Assessment for the project is conducted following the ASTM E1527-05 standard, demonstrating that the soil is clean or, that the pipe is sleeved using a metal or other material that is impermeable to solvents and petroleum products and so would not combine with past impacts of contaminated soils or groundwater. This would be a **less-than-significant** cumulative water quality impact, and the project's contribution would not be considerable. | LTS Cumulative Impact | No mitigation measures are necessary because the cumulative impact is less than significant. | Not Cumulatively Considerable |
| **Additive MTBE and TBA Impacts**<br>The use of PEX tubing for human consumption uses has the potential to contribute to drinking water contamination from MTBE or TBA when used in combination with certain environmental conditions. This impact has the greatest potential to occur where the source water (either well water or water from a public water provider) also contains those contaminants. In that case, depending on the situation, the water served by a public water provider or a well, for example, could contain a level of a contaminant, such as MTBE, that does not exceed the MCL. However, combined with the MTBE from PEX, also below the California MCL for MTBE, the MCL could be exceeded, even though the contribution from PEX is individually insignificant. Therefore, the cumulative impact on drinking water from chemicals leaching from PEX in combination with certain environmental conditions would be **significant**, and the project's contribution would be **potentially cumulatively considerable**. | S Cumulative Impact | **5-1: Cumulative Noncompliance with Drinking Water Standards Resulting from Leaching.**<br>For water service areas that have detectable levels of MTBE or TBA in drinking water or where there is known MTBE or TBA contamination of a source of drinking water, PEX tubing installed for human consumption uses must be certified not to leach detectable levels of MTBE or TBA. | Not Cumulatively Considerable |

NI = No Impact    LTS = Less than Significant    S = Significant    PS = Potentially Significant    SU = Significant and Unavoidable

# 2 INTRODUCTION

## 2.1 PURPOSE OF THE ENVIRONMENTAL IMPACT REPORT

The California Building Standards Commission (BSC) has prepared this draft environmental impact report (DEIR) to disclose the potential environmental effects of the proposed adoption of new state plumbing code regulations that would authorize the statewide use of cross-linked polyethylene (PEX) tubing in various cold and hot water plumbing applications (including potable water uses). This DEIR was prepared in compliance with the California Environmental Quality Act (CEQA) of 1970 (as amended through Public Resources Code Section 21000 et seq.) and the State CEQA Guidelines (California Code of Regulations Section 15000 et seq.). An EIR is a full disclosure, public information document in which the significant environmental impacts of a project are evaluated, feasible measures to mitigate significant impacts are identified, and alternatives to the project that can reduce or avoid significant environmental effects are considered.

An EIR is an informational document used in the planning and decision-making process by the lead agency and responsible agencies. The lead agency is the public agency with primary responsibility over the project. In the case of the proposed project, the lead agency is the BSC, which will be responsible for overall project approval.

The purpose of an EIR is not to recommend either approval or denial of a project. CEQA requires decision-makers to balance the benefits of a project against its unavoidable environmental effects in deciding whether to carry out a project. The lead agency will consider the DEIR, comments received on the DEIR, and responses to those comments before making a decision. “Findings”are prepared to disclose the disposition of significant environmental effects and, if environmental impacts are identified as significant and unavoidable, the lead agency may still approve the project if it determines that the social, economic, or other benefits outweigh the unavoidable impacts. The lead agency would then be required to prepare a “Statement of Overriding Considerations” that discusses the specific reasons for approving the project, based on information in the DEIR and other information in the record.

## 2.2 SCOPE OF THE ENVIRONMENTAL IMPACT REPORT

Pursuant to Section 15143 of the State CEQA Guidelines, a lead agency may limit the EIR’s discussion of environmental effects to specific issues where significant effects on the environment may occur. The BSC used a variety of information sources to determine which issue areas would result in potentially significant or significant effects on the environment. This information included review of previous PEX tubing administrative proceedings, reported cases relating to the adoption of PEX regulations and other relevant litigation, studies, manufacturer installation guidelines, project characteristics, comments from the public, responsible agency consultation, and comments received on the notice of preparation (NOP). An NOP was circulated to public agencies and the public on October 31, 2007, for a 30-day review period. Public scoping meetings were held in a variety of locations throughout the state in November 2007 (Table 2-1). A listing and summary of comments received on the NOP are included in Appendix B. The project description has not changed since publication of the NOP.

**Table 2-1**
**November 2007 Public Scoping Meetings**

| City | Location | Address | Date | Time |
|---|---|---|---|---|
| Sacramento | Public Meeting Room | 915 Capital Mall<br>Room 587<br>Sacramento, CA 95814<br>City Parking Lot at 10th & L<br>Parking Garage at 9th & L | November 13, 2007 | 1–5 p.m. |

| Table 2-1<br>November 2007 Public Scoping Meetings | | | | |
|---|---|---|---|---|
| City | Location | Address | Date | Time |
| San Diego | Public Auditorium | 1350 Front Street<br>Auditorium -Room B-109<br>San Diego, CA 92101 | November 14, 2007 | 9 a.m.–12 p.m. |
| Riverside | Cesar Chavez Community Room | 2060 University Avenue<br>Riverside, CA 92522 | November 15, 2007 | 1–3 p.m. |
| Burbank | City Council Chamber | 275 Olive Ave<br>Second Floor<br>Burbank, CA 91502 | November 16, 2007 | 9 a.m.–1 p.m. |
| Redding | Redding Public Library | 1100 Parkview Avenue<br>Redding, CA 96001 | November 19, 2007 | 1–3 p.m. |
| Fresno | Public Meeting Room | 2550 Mariposa Mall<br>Room 1036<br>Fresno, CA 93721 | November 20, 2007 | 1–3 p.m. |
| Santa Clara | Redwood Room | Central Park Library<br>2635 Homestead Rd<br>Santa Clara, CA 95051 | November 29, 2007 | 1–5 p.m. |
| Source: Data compiled by EDAW in 2008 | | | | |

Review of comments on the NOP, public scoping comments, and preliminary analysis indicates that the proposed project has the potential to result in significant adverse effects on the environment in specific issue areas. These include:

- air quality;
- public health and hazards;
- solid waste;
- water quality; and
- cumulative and growth-inducing impacts.

Consequently, the scope of this DEIR focuses on these issue areas.

## 2.3 EFFECTS FOUND NOT TO BE SIGNIFICANT

This section contains a discussion of the environmental effects found not to be significant pursuant to the State CEQA Guidelines Section 15128, which provides that "[a]n EIR shall contain a statement briefly indicating the reasons that various possible significant effects of a project were determined not to be significant and were therefore not discussed in detail in the EIR."

Based on the NOP, public comments on the NOP, and preliminary analysis, the project would have less-than-significant impacts on the following environmental issue areas:

- aesthetics,
- agricultural resources,
- biological resources,
- cultural resources,
- geology and soils,
- hydrology,
- land use and planning,
- mineral resources,

- noise,
- population and housing,
- public services,
- recreation,
- transportation and traffic, and
- utilities and service systems.

The proposed project is the adoption of regulations (i.e., building standards) pertaining to the use of PEX tubing for hot and cold water (including potable water) uses. The proposed PEX tubing regulations would apply to all occupancies, including commercial, residential, and institutional building construction, rehabilitation, and repair in all areas of the state. If the proposed regulations are adopted, PEX tubing would likely be used in projects that involve ground-disturbing activities and site-specific impacts. Some, perhaps many, will involve environmental review pursuant to CEQA. Because adoption of the proposed regulations would not in and of itself result in approval of any specific development, this DEIR does not evaluate any impacts of construction, modification to structures, or site-specific impacts.

Because implementation of the proposed project would not have any site specific-impacts, it would not cause any change in the visual environment; result in conversion of farmland to nonagricultural use; have a substantial adverse effect on any sensitive biological resources; disturb archeological or historic resources; result in significant geologic or soil impacts; increase water use, storm drainage flows, or the substantial alteration of drainage patterns; conflict with land use plans or habitat conservation plans; alter subsurface mineral resources; increase in ambient noise levels; result in population increase or demand for additional housing; require new or physically altered government facilities; increase use of parks or recreational facilities; cause an increase in traffic; or result in substantial demand for new public services. Implementation of the proposed project is not anticipated to result in any significant environmental effects in these environmental issue areas, and they are not evaluated further in this DEIR.

## 2.4 LEAD AND RESPONSIBLE AGENCIES

As defined in State CEQA Guidelines Section 15367, the lead agency is the public agency that has the principal responsibility for carrying out or approving the project. Other state or local public agencies that may or will use the EIR to carry out their discretionary approval power over the project are Responsible Agencies, as defined by CEQA Section 21069 and State CEQA Guidelines Section 15381.

The BSC is the lead agency with primary authority for approval of the project. Additional agencies (listed below) with approval authority over the project, or elements thereof, will have the opportunity to review this document during the public review period, and will use this information for the adoption of regulations. Cities and counties are not responsible agencies for purposes of this project because they do not have approval authority over State of California plumbing regulations.

### 2.4.1 LEAD AGENCY

- California Building Standards Commission (project approval)

### 2.4.2 STATE RESPONSIBLE AGENCIES

- California Department of Housing and Community Development
- California Division of the State Architect
- California Office of Statewide Health Planning and Development
- California Department of Public Health
- California Department of Food and Agriculture

## 2.5 PUBLIC REVIEW PROCESS

Consistent with the requirements of CEQA, a good faith effort has been made during the preparation of this DEIR to contact affected agencies, organizations, and individuals who may have an interest in the project. As described above, this effort included the circulation of the NOP on October 31, 2007. In addition, several public scoping meetings were held in a variety of locations throughout the state in November 2007 (Table 2-1). In addition, early consultation with relevant agencies, organizations, and individuals assisted in the preparation of this DEIR. The BSC has filed a notice of completion (NOC) with the Governor's Office of Planning and Research, State Clearinghouse, indicating that this DEIR has been completed and is available for review and comment by the public. This DEIR is being circulated for a 45-day public review period (beginning May 9, 2008 and ending June 23, 2008), during which time written comments will be received at the following address:

California Department of General Services
Real Estate Services Division
Professional Services Branch, Environmental Services Section
Attn: Valerie Namba, Senior Environmental Planner
707 Third Street, Third Floor, MS 509
West Sacramento, CA 95605-9052
Telephone: (916) 376-1607

Copies of the DEIR are available for review online at www.bsc.ca.gov and at the following addresses:

California Department of General Services
Real Estate Services Division
Professional Services Branch, Environmental Services Section
707 Third Street, Suite 3-400
West Sacramento, CA 95605

California Building Standards Commission
2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833

Public hearings on this DEIR will be held in Sacramento, Los Angeles, and San Francisco the week of June 2, 2008, during the review period, to receive oral comments on the document (see Table 2-2 below). Public notices of availability of the DEIR, which include the dates, times, and specific locations for the public hearings, have been published in the *Los Angeles Times*, *San Francisco Chronicle*, *Sacramento Bee*, *Fresno Bee*, and the *Redding Record Searchlight* newspapers.

**Table 2-2**
**Draft EIR Public Hearings**

| City | Location | Address | Date | Time |
|---|---|---|---|---|
| Sacramento | Room 500 | Department of Consumer Affairs<br>1625 N. Market Boulevard<br>Hearing Room<br>Sacramento, CA 95834 | Tuesday, June 3 | 2–4 p.m. |
| San Francisco | Auditorium | 455 Golden Gate Avenue<br>Auditorium<br>San Francisco, CA 94102 | Wednesday, June 4 | 2–4 p.m. |
| Los Angeles | Auditorium | Ronald Reagan Building<br>Auditorium<br>300 S. Spring Street<br>Los Angeles, CA 90013 | Friday, June 6 | 10 a.m.–12 p.m. |

## 2.6 TERMINOLOGY USED IN THE ENVIRONMENTAL IMPACT REPORT

This DEIR includes the following terminology to denote the significance of environmental impacts of the project:

- **Less-Than-Significant Impact:** A less-than-significant impact is one that would not result in a substantial and adverse change in the environment. This impact level does not require mitigation.

- **Potentially Significant Impact:** A potentially significant impact is one that, if it were to occur, would be considered a significant impact as described above; however, the occurrence of the impact cannot be definitely determined. For CEQA purposes, a potentially significant impact is treated as if it were a significant impact and would require mitigation.

- **Significant Impact:** CEQA Section 21068 defines a significant impact as one that causes "a substantial, or potentially substantial, adverse change in any of the physical conditions in the area affected by the project." Feasible mitigation measures or alternatives to the project must be considered to reduce the magnitude of significant impacts to less-than-significant levels.

- **Significant and Unavoidable Impact:** A significant and unavoidable impact is one that would result in a substantial adverse effect on the environment that cannot be feasibly mitigated to a less-than-significant level. A project with significant unavoidable impacts can still be approved, but BSC would be required to prepare a Statement of Overriding Considerations, pursuant to State CEQA Guidelines Section 15093, explaining the social, economic, or other benefits of the project that outweigh the significant environmental impacts.

- **Thresholds of Significance:** A criterion to define at what level an impact would be considered significant. A criterion is defined based on examples found in CEQA or the State CEQA Guidelines, scientific and factual data relative to the lead agency jurisdiction, views of the public in affected areas, the policy/regulatory environment of affected jurisdictions, and other factors.

## 2.7 ENVIRONMENTAL IMPACT REPORT ORGANIZATION

This DEIR is organized into chapters, as identified and briefly described below. Chapters are further divided into sections (e.g., Section 4.1, "Air Quality").

**Chapter 1, "Executive Summary."** This section summarizes the project description, alternatives to the project, significant environmental impacts that would result from the project, and mitigation measures proposed to reduce or eliminate those impacts.

**Chapter 2, "Introduction."** Chapter 2 describes the purpose and organization of the DEIR, context, and terminology used in the DEIR.

**Chapter 3, "Description of the Proposed Project."** Chapter 3 describes project location, background, proposed actions by the BSC, project characteristics, and project objectives. This chapter also describes PEX tubing and project regulatory requirements.

**Chapter 4, "Affected Environment, Thresholds of Significance, Environmental Impacts, and Mitigation Measures."** For each environmental issue area, this chapter describes the existing environmental setting, discusses the environmental impacts associated with the proposed project, and identifies mitigation for the impacts.

**Chapter 5, "Cumulative Impacts."** This chapter contains a discussion of cumulative impacts that would result from the proposed project in combination with past projects, past environmental impacts, current projects, and probable future projects in the project area.

**Chapter 6, "Other CEQA Required Sections."** The potential for the project to foster economic or population growth, remove obstacles to growth, or to result in significant irreversible environmental changes, is evaluated in Chapter 6. Project and cumulative impacts that cannot be mitigated to a less-than-significant level are also documented in this chapter.

**Chapter 7, "Alternatives to the Project."** This chapter describes the No Project Alternative and alternatives to the project that could mitigate the project's environmental impacts while meeting most of the project's objectives at a level consistent with CEQA requirements outlined in State CEQA Guidelines Section 15126.6(d). This chapter also describes alternatives previously considered and rejected.

**Chapter 8, "Preparers of the Environmental Document."** This chapter identifies the DEIR authors and consultants who provided analysis in support of the DEIR's conclusions.

**Chapter 9, "References."** This chapter sets forth a comprehensive listing of all sources of information used in the preparation of the DEIR, including agencies or individuals consulted during preparation of the DEIR.

**Appendices.** Appendices contain various technical reports, letters, official publications, summarized or otherwise used for preparation of the DEIR.

## 2.8 TECHNICAL STUDIES AND REPORTS USED IN THE ENVIRONMENTAL IMPACT REPORT

The primary studies and reports used to support the analysis presented in this DEIR are included in the appendices. All of the studies and reports used in the preparation of this DEIR are available for review at California Department of General Services, Real Estate Services Division, Professional Services Branch, Environmental Services Division, 707 Third Street, Suite 3-400, West Sacramento, CA 95605.

# 3 DESCRIPTION OF THE PROPOSED PROJECT

The California Building Standards Commission (BSC) proposes to adopt new state plumbing code regulations that would remove the prohibition against the use of cross-linked polyethylene (PEX) tubing, a type of plastic pipe, for potable water uses from the California Plumbing Code. The tubing would be authorized for use in various cold and hot water (including potable water) plumbing applications in residential, commercial, and institutional buildings. This proposed adoption would be an activity undertaken by a public agency and has the potential to result in direct or indirect physical changes in the environment. As such, it constitutes a “project” under the California Environmental Quality Act (CEQA) (Public Resources Code Section 21065).

This chapter presents the location and setting of the proposed project, project background, and project goals and objectives. In addition, it provides an overview of the project, describes the different methods for cross-linking polyethylene, and presents project alternatives.

## 3.1 LOCATION AND SETTING

The proposed adoption of regulations related to PEX tubing is a statewide regulatory change. As such, the project area is the State of California (Exhibit 3-1).

## 3.2 PROJECT BACKGROUND

BSC is a state agency responsible for approving and adopting building standards adopted or proposed by other agencies and BSC staff. Building standards ordinarily are based on model codes with any amendments or deletions deemed appropriate. Model codes are created by nonprofit organizations made up of government officials and industry representatives from across the nation, or around the globe if the model code is international. The popularity of model building codes can be attributed to two factors: (1) proprietary building codes are prohibitively expensive to develop and (2) model codes can accommodate local conditions. Modern building regulations are very complex; therefore, most jurisdictions are not technically or financially capable of developing and effectively maintaining them. Rather than drafting its own building codes, a state might choose to use the model building codes instead. The model building codes are either adopted (accepted without modifications) or adapted (modified) to a particular jurisdiction and then enforced by the adopting authority. In California, building standards approved or adopted by BSC become part of the California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code, of which the California Plumbing Code (CPC) is a part. The CPC is a compilation of three types of plumbing standards from three different origins:


Source: Created by EDAW in 2008

**Proposed Project Area** **Exhibit 3-1**

- plumbing standards that have been adopted by state agencies without change from plumbing standards contained in national model codes;

- plumbing standards that have been adopted and adapted from the national model code standards to meet California conditions; and

- plumbing standards, authorized by the California legislature, that constitute extensive additions not covered by the model codes that have been adopted to address particular California concerns, which become part of the CPC.

Model building codes are developed by independent standards organizations. These organizations put together a network of development committees comprising representatives from the various affected entities, both government and private. This method allows the standards organizations to pool the financial and intellectual resources to produce codes that remain current and technically sound. The model code developers are constantly working to update their codes to incorporate the latest research results and building technologies. Normally, model building codes are updated and a new edition of the model building code is published every 3 years. The adopted code is based on the most recent version of the model building code. However, because of the length of time that it takes for a jurisdiction to review and approve a new code, the currently enforced version of the state code is often not the most recent edition of the model building code. Also, when any given jurisdiction adopts a model building code, it adopts a specific edition of the model code. For example, the 2007 California Building Code is the adoption of the 2006 International Building Code with modifications, which then becomes the law of that jurisdiction. As a result of this practice, the adopted codes are not automatically updated. When a new edition of the model code is released by the model code developer, BSC and other adopting authorities may choose to ignore it and continue using the older version of the model code it adopted. California and most other jurisdictions update their codes triennially. State law requires the BSC to adopt the latest version of the model codes triennially; however, unforeseen circumstances can cause a disruption in this effort.

The model codes may either be adopted or rejected outright, or they may be adopted with amendments, deletions, or additional rules. In some cases, the amendments or additional requirements and exemptions are issued as a separate document. The State of California contracts with the International Association of Plumbing and Mechanical Officials (IAPMO) to print the California Building Standards Code, Part 5 of which is known as the CPC. The 2007 edition of the CPC incorporates, by adoption (with modifications), the 2006 edition of the Uniform Plumbing Code (UPC) model building code with the California State revisions.

IAPMO, a nonprofit organization, published the 2000 UPC, a model code, in October 1999. It included, for the first time, provisions allowing the use of PEX tubing and fittings for hot and cold water distribution, including potable water uses. Membership in IAPMO is open to anyone who has an interest in promoting the installation of safe and efficient plumbing and mechanical products (e.g., heating, ventilating, cooling, and refrigeration systems). IAPMO members are located in over 40 U.S. states and in many foreign countries including Canada, Japan, New Zealand, Mexico, and Saudi Arabia. IAPMO develops the UPC and the Uniform Mechanical Code, the world's only plumbing and mechanical codes accredited by the American National Standards Institute (ANSI).

During the adoption cycle for the 2001 triennial code, BSC proposed to adopt regulations approving the use of PEX tubing for potable water uses along with other proposed regulatory changes. However, BSC received comment letters during the regulatory process that suggested a number of potentially adverse environmental and public health effects associated with the use of PEX for potable water distribution. Based on the information in those comment letters, BSC and the Responsible Agencies withheld approval of the PEX provisions by affirmatively not adopting it for most potable water applications under their jurisdictions, pending future environmental review in compliance with CEQA. See Table 6-4, "UPC," in section 3.4.2, "Proposed Regulations," below for the currently proposed regulatory change that would strikeout the 2001 non-adoption language.

The Plastic Pipe and Fittings Association (PPFA) sued BSC, seeking to require BSC to adopt the PEX provisions. The trial court ruled in favor of PPFA, but that decision was overturned by the appellate court, which held that BSC's decision to withhold approval until PEX could be further reviewed was supported by "substantial evidence" as defined by CEQA (*Plastic Pipe and Fittings Assn. v. California Building Standards Com'n* [2004] 124 Cal.App.4th 1390). Specifically, the court found that information contained in a comment letter received by BSC from Thomas Reid on behalf of the Coalition for Safe Building Materials (the Coalition) "is substantial evidence both that PEX potentially may present an unreasonable risk of harm and that the information in the administrative record is insufficient to dispel the stated concerns" regarding the integrity of PEX tubing. Therefore, BSC was entitled to rely on that letter in rendering its decision to require an environmental impact report (EIR). The Coalition is a group made up of the California Pipe Trades Council, California Professional Firefighters, Consumer Federation of California, Planning and Conservation League, Center for Environmental Health, Sierra Club of California, and Communities for a Better Environment.

In 2006, the California Department of Housing and Community Development (HCD) sought to adopt regulations allowing use of PEX and completed an initial study/negative declaration on September 9, 2006 (HCD 2006a). However, HCD withdrew the initial study/negative declaration on October 16, 2006 because of ongoing controversy and the perceived need for more in-depth analysis.

Each iteration of the UPC from 2000 to the present has maintained the approval of PEX for hot and cold water distribution. However, California has not yet removed the prohibition in the CPC against the use of PEX tubing and fittings for hot and cold potable water distribution.

Based on substantial evidence in the record, BSC has determined that the project has the potential to have a significant effect on the environment and therefore has concluded that an EIR is required. This EIR provides the information necessary for BSC to draw conclusions regarding the potential environmental and human health effects of PEX tubing and its appropriateness for a variety of hot and cold water applications.

## 3.3 PROJECT OBJECTIVES

BSC proposes adoption of new state plumbing code regulations that would authorize the statewide use of PEX tubing for various cold and hot water (including potable water) plumbing applications in residential, commercial, and institutional buildings. Responsible Agencies, each of which will rely on this EIR for its own adoption of regulations, will be HCD, Division of the State Architect (DSA), Office of Statewide Health Planning and Development (OSHPD), Department of Public Health (DPH) (previously known as DHS), and the Department of Food and Agriculture (DFA). Cities and counties would not be responsible agencies because they would not have any authority to approve the project or to disapprove or add requirements or restrictions relating to the use of PEX within their jurisdictions after it is approved by BSC, unless they make express findings for such additions or deletions based on climatic, topographical, or geological conditions (CPC 101.8.1). BSC's objective in proposing these regulations is to provide an alternative plastic hot and cold water plumbing material for use in California.

## 3.4 PROJECT DESCRIPTION

### 3.4.1 PROJECT OVERVIEW

The proposed project is the adoption of regulations (i.e., building standards) pertaining to the use of PEX tubing. Implementation of the proposed project would allow the statewide use of PEX tubing for hot and cold water (including potable water) distribution for applications under the jurisdiction of the Responsible Agencies that adopt regulations based on environmental information and conclusions in this EIR. This includes applications such as drinking water, irrigation, and wastewater. The proposed PEX tubing regulations would apply to all occupancies, including commercial, residential, and institutional building construction, rehabilitation, and repair in all areas of the state. Examples of commercial occupancies include retail establishments, restaurants, office buildings, salons, theaters, farms, ranches, and food processing plants. Residential buildings include, but are not limited to, single-family dwellings, apartment houses, hotels, motels, lodging houses, dwellings, dormitories, condominiums, shelters for homeless persons, congregate residences, employee housing, factory-build housing, permanent buildings and permanent accessory buildings or structures constructed within manufactured home parks and special occupancy parks, and other types of dwellings containing sleeping accommodations with or without common toilet or cooking facilities including accessory buildings and facilities. Institutional building examples include schools and hospitals.

In this EIR, the terms "PEX tubing" and "PEX" refer to cross-linked polyethylene (PE) tubing also known as PEX tubing unless the context clearly indicates otherwise. These regulations, if approved, would become part of the CPC, which is a part of the California Building Standards Code. BSC is responsible for the final approval and adoption of the California Building Standards Code. BSC receives proposed code revisions from a number of public agencies that have statutory authority to propose codes for various types of occupancies. The Responsible Agencies for this project have regulatory authority over the commercial, residential, and institutional occupancies to which the proposed regulations would apply.

## 3.4.2 PROPOSED REGULATIONS

California Health and Safety Code Sections 18928, 18938, 17922, and 19990 direct BSC and the Responsible Agencies to adopt building standards that are reasonably consistent with recognized and accepted standards contained in the most recent editions of the UPC. California adopts the UPC on a triennial basis with modifications in strikeout for deletions and italics and underline for additions. This revised code becomes the CPC; no finalized version (i.e., without changes shown in strikeout and underlined italics) is prepared. BSC has selected the 2006 UPC published by IAPMO as the model code for this code adoption cycle. The proposed project is a change to Part 5, Title 24, CCR (hereinafter referred to as CPC), which is applicable to buildings under the jurisdiction of BSC, DFA, DPH, DSA, HCD, and OSHPD. Currently, PEX is authorized for use in radiant heating systems, manufactured homes, certain approved institutional uses, and for hot and cold water distribution, including potable water uses in some local jurisdictions (as discussed in Section 3.4.4 below). However, PEX was specifically not adopted (i.e., it was deleted) in the 2007 CPC for uses under the jurisdiction of BSC and the Responsible Agencies.

**TABLE 6-4. UPC**

| Material | Water Distribution Pipe and Fittings | | Building Supply Pipe and Fittings |
|---|---|---|---|
| | Hot | Cold | |
| Asbestos – Cement | | | X |
| Brass | X | X | X |
| Copper | X | X | X |
| Cast Iron | X | X | X |
| CPVC | X | X | X |
| Galvanized Malleable Iron | X | X | X |
| Galvanized Wrought Iron | X | X | X |
| Galvanized Steel | X | X | X |
| PE | | | X |
| PE-AL-PE | X | X | X |
| PEX ~~[1]~~ | X | X | X |
| PEX-AL-PEX[1] | X | X | X |
| PVC | | | X |

[1] [BSC, DSA/SS & HCD] The use of ~~PEX and~~ PEX-AL-PEX in potable water supply systems is not adopted ~~for applications under the~~

<table>
<tr><th colspan="4">TABLE 6-4. UPC</th></tr>
<tr><th rowspan="2">Material</th><th colspan="2">Water Distribution Pipe and Fittings</th><th rowspan="2">Building Supply Pipe and Fittings</th></tr>
<tr><th>Hot</th><th>Cold</th></tr>
<tr><td colspan="4">~~authority of the California Building Standards Commission, the Division of State Architect and the Department of Housing and Community Development.~~</td></tr>
</table>

The modifications to the existing plumbing code would entail the following changes. The above table (Table 6-4, "UPC") and text are excerpted from "The Express Terms for the Building Standards of the Building Standards Commission Regarding the Adoption of Amendments into the 2007 California Plumbing Code, California Code of Regulations," Title 24, Part 5. The proposed changes to the regulations involve deletion of exceptions to the adoption of PEX in the CPC. As no additions are proposed to the CPC, no text is in italics.

**604.1**
Exceptions:

~~**(2) [For OSHPD 1, 2, 3 & 4]** Use of PEX piping is not permitted for applications under the authority of the Office of Statewide Health Planning and Development.~~

~~**(4) [For BSC]** Use of PEX piping is not adopted for applications under the authority of the Department of Health Services and the Department of Food and Agriculture.~~

**604.11 PEX**. ~~***[Not Adopted by BSC, HCD, DSA/SS, DHS, AGR & OSHPD 1, 2, 3 & 4]***~~ Crosslinked polyethylene (PEX) tubing shall be marked with the appropriate standard designation(s) listed in Table 14-1 for which the tubing has been listed or approved. PEX tubing shall be installed in compliance with the provisions of this section.

**604.11.1 PEX Fittings.** ~~***[Not Adopted by BSC, HCD, DSA/SS, DHS, AGR & OSHPD 1, 2, 3 & 4]***~~ Metal insert fittings, metal compression fittings, and cold expansion fittings used with PEX tubing shall be manufactured to and marked in accordance with the standards for the fittings in Table 14-1.

**604.11.2 Water Heater Connections.** ~~***[Not Adopted by BSC, HCD, DSA/SS, DHS, AGR & OSHPD 1, 2, 3 & 4]***~~ PEX tubing shall not be installed within the first eighteen (18) inches (457mm) of piping connected to a water heater.

~~***(2) [For OSHPD 1, 2, 3 & 4]** Use of PEX piping is not permitted for applications under authority of the Office of Statewide Health Planning and Development.*~~

~~***(4) [For AGR, DHS]** Use of PEX piping is not adopted for applications under the authority of the Department of Health Services and the Department of Food and Agriculture.*~~

### 3.4.3 PEX DESCRIPTION

PEX is a form of plastic tubing. The materials used in the production of plastics are natural products such as cellulose, coal, natural gas, salt, and crude oil. Crude oil is a complex mixture of thousands of compounds. To become useful, it must be processed.

The production of plastic begins with a distillation process in an oil refinery. The distillation process involves the separation of heavy crude oil into lighter groups called fractions. Each fraction is a mixture of hydrocarbon chains (chemical compounds made up of carbon and hydrogen), which differ in terms of the size and structure of their molecules. One of these fractions, naphtha, is the crucial element for the production of plastics.

The two major processes used to produce plastics are called polymerisation and polycondensation, and they both require specific catalysts. In a polymerisation reactor, monomers like ethylene and propylene are linked together to form long polymer chains. (A polymer is a compound of high molecular weight that consists of long chains of repeated, linked units known as monomers). Each polymer has its own properties, structure, and size depending on the various types of basic monomers used.

There are many different types of plastics, and they can be grouped into two main polymer families: thermoplastics (which soften when heated and then harden again when cooled) and thermosets (which never soften when they have been molded). PEX is made of PE, often high-density PE (HDPE), which is a thermoplastic. PEX is a member of the polyolefin family of polymers along with normal PE, HDPE, polypropylene (PP), and polybutylene (PB). Polyolefins are produced from oil or natural gas. They can be processed in two ways to make products—by extrusion or molding.

To manufacture plastic tubing, a process known as profile extrusion is used. This process is used to manufacture plastic products with a continuous cross section, such as drinking straws, decorative molding, window trimming, plastic pipes, and a wide variety of other products. The plastic is fed in pellet form into the extruder machine's hopper. Then a rotating screw inside a heated barrel conveys the material continuously forward. The pellets are thus softened by both friction and heat. The softened plastic is then forced out through a die and directly into cool water where the product solidifies. This is similar to soft-serve ice cream coming out of a machine, except that the ice cream will melt rather than harden. From here it is conveyed onward into the take-off rollers, which pull the softened plastic from the die.

The die is a metal plate placed at the end of the extruder with a section cut out of its interior. This cutout, and the speed of the take-off rollers, determines the cross section of the product being manufactured. A simple way to understand this concept is to consider the shape of toothpaste as it comes out of a squeezed tube. The product comes out in a solid rod because of the opening at the end of the tube. If that opening had a differently shaped cross section, the product would take on that new cross section. Extrusion produces an inherently strong finished product, stronger than is produced by the molding process. This is one of the reasons that plastic pipe is rated at higher pressures than plastic fittings that are injection molded.

Cross-linked PE, or PEX, is a high-density plastic that is an alternative to ferrous and nonferrous piping for water distribution, such as copper, enamel coated steel, and chlorinated polyvinyl chloride (CPVC) plastic piping. Normal PE is unsuitable for hot water uses because it softens at elevated temperatures. However, for PE to be suitable for hot water uses, the individual polymer chains must be "cross-linked" together with supplemental chemical bonds. There are three commercial methods to cross-link polyethylene and thus, three classes of PEX:

(1) PEX-A uses the "Engle method" wherein the polyethylene resin and a chemical additive are heated to produce cross-linking. In the Engel method, peroxide is added to the base resin, which is then passed through an extruder. Through a combination of pressure and high temperature, the cross-linking takes place as the tubing is produced.

(2) PEX-B employs the "silane method" to produce silicon-oxygen cross-link bonds. The silane method, also called the moisture-cure method, involves grafting a reactive silane molecule to the backbone of the PE. The PEX tubing is produced by blending this grafted compound with a catalyst. While some of the cross-linking occurs in the extruder, the majority actually takes place in a water bath or in a sauna at elevated temperatures after the tubing passes through the extruder.

(3) PEX-C uses gamma or electron beam radiation to initiate cross-linking in what is called the "irradiation method." The tubing is extruded like normal and HDPE tubing is then taken to an electron beam facility where it is dosed with a specific amount of radiation to initiate molecular cross-linking.

Because the different classes of PEX are formulated in different ways, they may perform differently or result in different environmental impacts. These possibilities are evaluated in Section 4.2, "Public Health and Hazards," and Section 4.4, "Water Quality," of this EIR.

In addition to cross-linking the polyethylene, other chemicals are added to the resin to prevent oxidation and ultraviolet light from weakening the tubing, which could lead to tubing failures. Such additives include antioxidants, ultraviolet blockers, fillers, and pigments.

## 3.4.4 CURRENT AND PROJECTED USES OF PEX

Use of PEX tubing is currently allowed throughout California for hydronic heating systems and all uses including potable water in manufactured homes. In the majority of existing buildings in California, including residential buildings, potable water pipe is made of metal, though CPVC plastic pipe was recently approved for statewide potable water uses, including use in residential buildings, beginning January 1, 2008. PEX tubing may also be used if it is approved by local ordinance or if the local agency with jurisdiction has approved it as an alternate material under the Alternate Materials, Methods of Design, and Methods of Construction provisions of the CPC. This provision authorizes local building officials to approve, on a project-by-project basis, alternate materials, provided the building official finds that the proposed design is satisfactory and complies with the provisions of the technical codes, and that the material, method, or work offered is, for the purpose intended, at least the equivalent of that prescribed in the technical codes in suitability, strength, effectiveness, fire resistance, durability, safety, and sanitation. (See California Health and Safety Code Section 17951[e], CPC 301.1 et seq. and CPC 108.7 et seq.) Such approval requires that the project proponent submit proof to support the building official's findings. It also must be recorded and entered in the local building departments files. Under these provisions, building officials may require an applicant to arrange for an outside agency designated by the building official at the applicant's expense to review an evaluation of the proposed alternate materials, methods of design, and methods of construction. In contrast, in the three jurisdictions that have approved the use of PEX by ordinance, no special approvals or submittals are needed to use PEX in a project.

Nearly 200 California cities and nearly 30 California counties have approved the use of PEX tubing in various cold and hot water plumbing (including potable water) applications in residential, commercial, and institutional buildings within their jurisdictions using the alternate materials provisions. In addition, at least three California cities (Palo Alto, Highland, and Santa Clarita) have adopted ordinances allowing the use of PEX tubing for all uses approved in the UPC without requiring special documentation. PEX currently makes up approximately 37% of the market for plumbing materials in new single-family homes in California. If the proposed regulations are adopted, PEX would be used in cities and counties that do not currently allow its use, and use of PEX would be expected to increase in the cities and counties that already allow PEX as an alternate material.

As of 2005 the market share for plumbing materials for all types of uses (including hydronic radiant heating and potable water distribution) in new homes in California was approximately 29% PEX, 13% CPVC, 54% copper, and 4% for all other materials. Market share, in this instance, means the percentage of new single-family homes that were plumbed with PEX. Other plumbing materials include galvanized steel and PEX-AL-PEX (polyethylene with an aluminum layer). (HCD 2006b and Ash, pers. comm. 2008.) Though more current market share data for copper and CPVC is not available, the most current data for PEX (2006) indicates that its share of the market for plumbing materials in new homes in California was approximately 37% (Ash, pers. comm. 2008). The net effect of adoption of the proposed regulations would probably be an increase in the use of PEX tubing, with a proportionate decrease in the use of other piping materials, particularly copper, because of the reduced labor costs associated with installation of PEX and also because of corrosivity issues with copper piping resulting from the increased use of chloramines for drinking water disinfection. The issue of corrosivity is discussed in further detail in Section 4.2, "Public Health and Hazards," and Section 4.4, "Water Quality."

## 3.5 REGULATORY REQUIREMENTS, PERMITS, AND APPROVALS

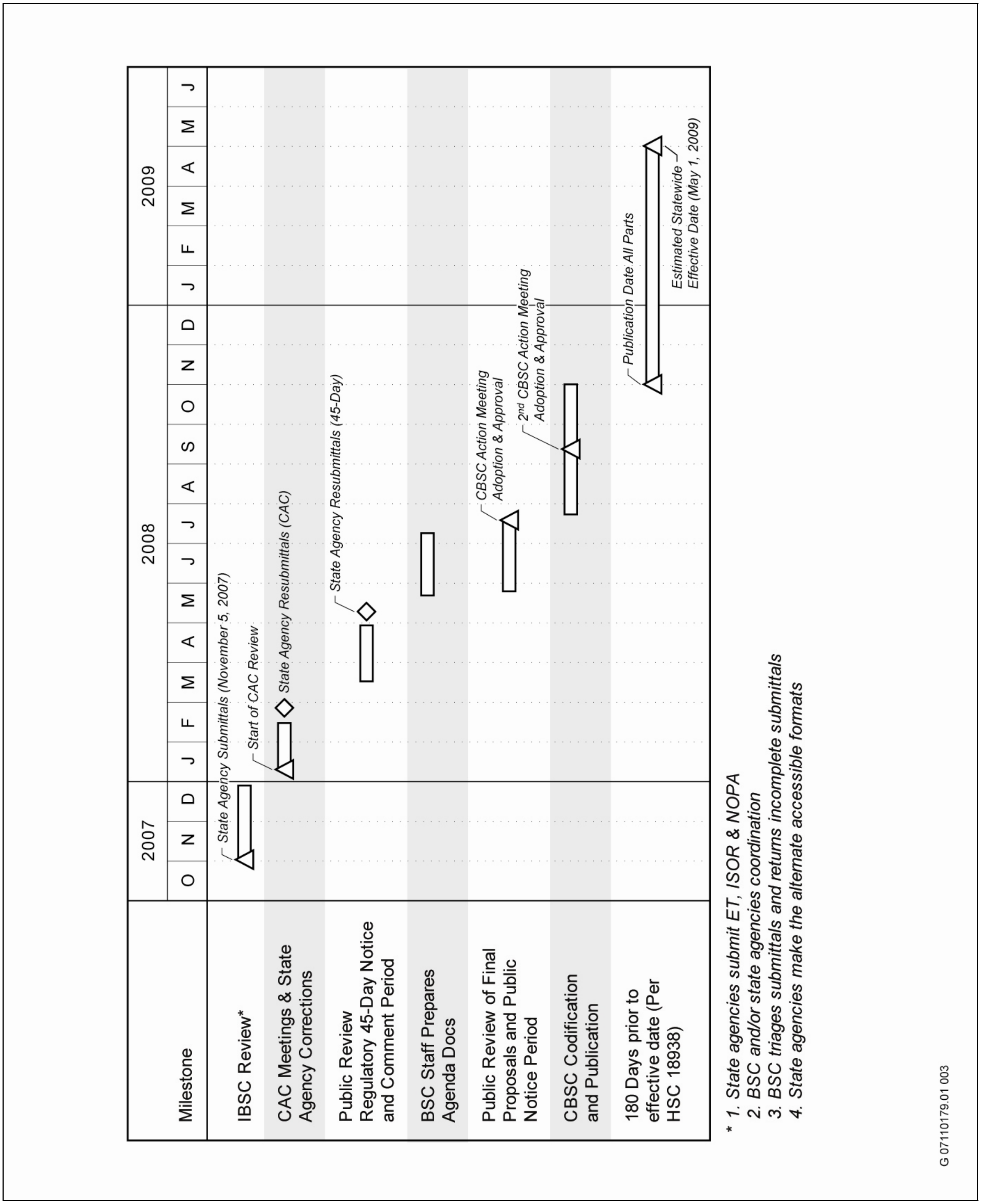
Two independent but related processes are taking place with regard to the proposed PEX regulations: the regulatory process and the EIR process.

Proposed draft regulatory changes were submitted to BSC by the Responsible Agencies in November of 2007. The BSC Code Advisory Committee held meetings regarding the proposed regulations in late January and early February 2008. The Plumbing, Electrical, Mechanical, and Energy BSC Code Advisory Committee considered all public comments in January, 2008 and relied on their own expertise in developing their recommendations to the BSC. After consideration of these recommendations by the pertinent state agencies, the original or revised proposed regulations were submitted to BSC by March 10, 2008 and a 45-day formal public review and comment period commenced March 28, 2008 and ends on May 12, 2008. BSC and the pertinent state agencies will prepare written responses to the comments received during the formal comment period. Exhibit 3-2 illustrates the draft regulatory timeline.

If, after this EIR is certified, BSC determines that the EIR supports a decision to approve the proposed regulatory changes, BSC may rely on the certified final EIR for subsequent approval of the proposed regulatory changes. In addition, the certified EIR will be forwarded to the Responsible Agencies, which may also rely on the final EIR for changes to their regulations, to the extent that those changes are within the scope of this EIR. If significant changes to the regulations are made after the publication of this draft EIR (DEIR), the DEIR will be revised as necessary to reflect those changes and, if necessary, recirculated.

## 3.6 SCOPE OF THIS EIR

The proposed project is limited to the proposed adoption of plumbing regulations to allow use of PEX tubing in a variety of hot and cold water applications (including potable water). These uses would apply to commercial, residential, and institutional building projects under the jurisdiction of the Lead Agency and Responsible Agencies in all California cities, cities and counties, and counties. The EIR will not assess any specific project that involves direct construction or modification to structures. Therefore, the environmental review will not include site specific analyses. In addition, the EIR will not evaluate the use of PEX-AL-PEX. PEX-AL-PEX is PEX tubing with a layer of aluminum embedded between the PEX layers. The proposed regulations will not address certain other potential uses of PEX tubing, such as for specific industrial or medical devices or machines. Uses other than cold and hot water plumbing uses (including potable water uses) for commercial, residential, and institutional buildings are beyond the scope of this project and thus beyond the scope of this EIR.




Source: Provided by the California Building Standards Commission in 2007, adapted by EDAW in 2008

**Draft 2007 Annual Code Adoption Cycle (2007 Codes Supplement)** **Exhibit 3-2**

# 4 AFFECTED ENVIRONMENT, THRESHOLDS OF SIGNIFICANCE, ENVIRONMENTAL IMPACTS, AND MITIGATION MEASURES

Sections 4.1 through 4.4 of this draft environmental impact report (DEIR) discuss regulatory and existing environmental settings, environmental impacts associated with implementation of the project, mitigation measures to reduce the level of impact, and residual impacts (i.e., the remaining impacts after implementation of any proposed mitigation measures). Issues evaluated in these sections consist of a range of environmental topics originally identified for review in the notice of preparation (NOP) prepared for the proposed project. The NOP is included as Appendix A. Sections 4.1 through 4.4 each include the following components:

- **Regulatory Setting:** This subsection presents information on the laws, regulations, plans, and policies that relate to the issue area being discussed. Regulations originating from the federal, state, and local levels are each discussed as appropriate.

- **Existing Setting:** This subsection presents the existing environmental conditions in the project area as appropriate, in accordance with California Environmental Quality Act (CEQA) Guidelines (State CEQA Guidelines) Section 15125. The discussions of the existing setting focus on information relevant to the issue under evaluation.

- **Environmental Impacts:** This subsection identifies the impacts of the proposed project on the existing environment, in accordance with State CEQA Guidelines Sections 15126 and 15143. Before presenting an evaluation of impacts, the section describes the analysis methodology used and the thresholds of significance used to identify the following impacts. Project impacts are identified alphanumerically and sequentially throughout this subsection. For example, impacts in Section 4.4 are identified as 4.4-1, 4.4-2, and so on. An impact statement precedes the discussion of each impact and provides a summary of the impact and its level of significance. The discussion that follows the impact statement includes the evidence on which a conclusion is made regarding the level of impact. The discussions of cumulative impacts and growth-inducing impacts are presented in Chapter 5 and Chapter 6 of this DEIR, respectively.

    - **Mitigation Measures:** This subsection identifies potentially feasible mitigation measures to reduce significant and potentially significant impacts of the proposed project, in accordance with State CEQA Guidelines Section 15002(a)(3), Section 15021(a)(2), and Section 15091(a)(1). Each mitigation measure is identified alphanumerically to correspond with the number of the impact being reduced by the measure. For example, Impact 4.3-1 would be mitigated by Mitigation Measure 4.3-1.

    - **Level of Significance after Mitigation:** This subsection describes whether the mitigation measures would reduce impacts to less-than-significant levels and identifies any significant impacts that would remain significant following implementation of the mitigation measures. Any significant and unavoidable impacts are identified in this section and are also summarized in Chapter 6, "Other CEQA Sections."

# 4.1 AIR QUALITY

This section describes air quality conditions in California, the regulatory framework under which emissions are controlled, and the physical processes that affect air pollutant concentrations. This section also contains an analysis of potential air quality impacts associated with the proposed adoption of regulations that would allow the use of PEX tubing in various cold and hot water plumbing (including potable water) applications in residential, commercial, and institutional buildings. The information contained in this section is based, in part, on documents prepared by the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (ARB), and the California Department of Public Health (DPH).

Installation and repair of PEX tubing would not require the use of adhesives or solvents. In addition, because PEX is a form of plastic, installation and repair of PEX tubing does not require soldering. Potential issues related to air quality associated with the proposed project include the chemical composition of PEX tubing, indoor air pollution, and potential PEX tubing incineration hazards.

## 4.1.1 REGULATORY SETTING

California is divided into 58 counties, 35 air districts, and 15 air basins. Air quality within California is regulated by EPA, ARB, and local air districts. Each of these agencies develops rules, regulations, policies, and/or goals to comply with applicable legislation. Although EPA regulations may not be superseded, both state and local regulations may be more stringent.

Concentrations of several air pollutants—ozone, carbon monoxide (CO), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), respirable and fine particulate matter ($PM_{10}$ and $PM_{2.5}$), and lead—are used as indicators of ambient-air-quality conditions and are the focus of air quality regulations. Because these are the most prevalent air pollutants known to be deleterious to human health and extensive documents on health-effects criteria are available for them, they are commonly referred to as "criteria air pollutants."

Air quality regulations also focus on toxic air contaminants (TACs), or in federal parlance, hazardous air pollutants (HAPs). Acceptable levels of exposure of criteria air pollutants can be determined and ambient standards have been established for them (Table 4.1-1). EPA and ARB regulate HAPs and TACs, respectively, through statutes and regulations that generally require the use of the maximum or best available control technology for toxics (MACT and BACT) to limit emissions. These, in conjunction with additional rules set forth by local air districts, establish the regulatory framework for TACs.

Applicable regulations associated with criteria air pollutants, TACs, and greenhouse gas (GHG) emissions are described below. Criteria air pollutants, TACs, and GHG emissions are described further in Section 4.1.2, "Existing Setting."

### FEDERAL PLANS, POLICIES, REGULATIONS, AND LAWS

#### Criteria Air Pollutants

At the federal level, EPA has been charged with implementing national air quality programs. EPA's air quality mandates are drawn primarily from the federal Clean Air Act (CAA), which was enacted in 1970. The most recent major amendments made by Congress were in 1990.

The CAA requires EPA to establish national ambient air quality standards (NAAQS). As shown in Table 4.1-1, EPA has established primary and secondary NAAQS for the following criteria air pollutants: ozone, CO, $NO_2$, $SO_2$, $PM_{10}$, $PM_{2.5}$, and lead. The primary standards protect the public health and the secondary standards protect public welfare. EPA establishes national attainment designations for the NAAQS.

**Table 4.1-1**
**Ambient Air Quality Standards**

| Pollutant | Averaging Time | California Standards [2,3] | National Standards [1] Primary [3,4] | National Standards [1] Secondary [3,5] |
|---|---|---|---|---|
| Ozone | 1-hour | 0.09 ppm (180 μg/m³) | – [6] | – |
| | 8-hour | 0.07 ppm [8] (137 μg/m³) | 0.08 ppm (157 μg/m³) | Same as primary standard |
| Carbon monoxide (CO) | 1-hour | 20 ppm (23 mg/m³) | 35 ppm (40 mg/m³) | – |
| | 8-hour | 9 ppm (10 mg/m³) | 9 ppm (10 mg/m³) | |
| Nitrogen dioxide ($NO_2$) | Annual arithmetic mean | 0.030 ppm (56 μg/m³) | 0.053 ppm (100 μg/m³) | Same as primary standard |
| | 1-hour | 0.18 ppm (338 μg/m³) | – | |
| Sulfur dioxide ($SO_2$) | Annual arithmetic mean | – | 0.030 ppm (80 μg/m³) | – |
| | 24-hour | 0.04 ppm (105 μg/m³) | 0.14 ppm (365 μg/m³) | – |
| | 3-hour | – | – | 0.5 ppm (1300 μg/m³) |
| | 1-hour | 0.25 ppm (655 μg/m³) | – | – |
| Respirable particulate matter ($PM_{10}$) | Annual arithmetic mean | 20 μg/m³ | - [6] | Same as primary standard |
| | 24-hour | 50 μg/m³ | 150 μg/m³ | |
| Fine particulate matter ($PM_{2.5}$) | Annual arithmetic mean | 12 μg/m³ | 15 μg/m³ | Same as primary standard |
| | 24-hour | – | 35 μg/m³ | |
| Lead | 30-day Average | 1.5 μg/m³ | – | – |
| | Calendar Quarter | – | 1.5 μg/m³ | Same as primary standard |
| Sulfates | 24-hour | 25 μg/m³ | **No national standards** | |
| Hydrogen sulfide | 1-hour | 0.03 ppm (42 μg/m³) | | |
| Vinyl chloride [7] | 24-hour | 0.01 ppm (26 μg/m³) | | |
| Visibility-reducing particle matter | 8-hour | Extinction coefficient of 0.23 per kilometer—visibility of 10 miles or more (0.07—30 miles or more for Lake Tahoe) because of particles when the relative humidity is less than 70%. | **No national standards** | |

Notes: μg/m³ = micrograms per cubic meter; ppm = parts per million

1 National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic means) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. The $PM_{10}$ 24-hour standard is attained when 99% of the daily concentrations, averaged over 3 years, are equal to or less than the standard. The $PM_{2.5}$ 24-hour standard is attained when 98% of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact EPA for further clarification and current federal policies.

2 California standards for ozone, CO (except Lake Tahoe), $SO_2$ (1- and 24-hour), $NO_2$, PM, and visibility-reducing particles are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

3 Concentration expressed first in units in which it was promulgated [i.e., ppm or μg/m³]. Equivalent units given in parentheses are based on a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4 National primary standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

5 National secondary standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

6 The 1-hour ozone national ambient air quality standard (NAAQS) was revoked on June 15, 2005. The annual $PM_{10}$ NAAQS was revoked in 2006.

7 ARB has identified lead and vinyl chloride as toxic air contaminants with no threshold of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

Source: ARB 2008a

### Hazardous Air Pollutants

EPA has programs for identifying and regulating HAPs. Title III of the federal Clean Air Act Amendments (CAAA) directed EPA to issue national emissions standards for HAPs (NESHAP). The NESHAP may differ for major sources than for area sources of HAPs. Major sources are defined as stationary sources with potential to emit more than 10 tons per year of any HAP or more than 25 tons per year of any combination of HAPs; all other sources are considered area sources. The emissions standards were issued in two phases. In the first phase (1992–2000), EPA developed technology-based emission standards designed to produce the maximum emission reduction achievable. These standards are generally referred to as requiring MACT. For area sources, the standards may be different, based on generally available control technology. In the second phase (2001–2008), EPA issued emissions standards based on health risks where deemed necessary to address risks remaining after implementation of the technology-based NESHAP standards.

The CAAA also requires EPA to issue vehicle or fuel standards containing reasonable requirements that control TAC emissions, at a minimum for benzene and formaldehyde. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene. In addition, Section 219 requires the use of reformulated gasoline in selected areas with the most severe ozone nonattainment conditions to further reduce mobile-source emissions.

### Indoor Air Pollution

Indoor air pollution consists of toxic gases or particles that can be harmful to human health. Because of the enclosed nature and lack of assimilation capacity in most indoor spaces, indoor sources of toxic gases or particles can lead to higher levels of toxic gases than those found outdoors. Because there are many indoor sources of pollutants, and because people spend substantial time indoors, indoor exposures can be high and pose a risk to health. People may react differently to air pollutants, depending on factors such as age, preexisting medical conditions, and individual sensitivity. Immediate effects can include headache, nausea, asthma symptoms, irritation to the respiratory system or skin, fatigue, and dizziness. Long-term exposure may cause cancer, heart disease, and respiratory disease (ARB 2003). Specifically, failure of any type of plumbing materials can lead to moisture buildup in structures. If the failure goes unnoticed for an extended period of time in a poorly ventilated area of the structure, the potential exists for biological agents to grow and spread. Biological agents including bacteria, viruses, and fungi (e.g., molds) can cause allergic reactions; asthma; eye, nose, and throat irritation; and humidifier fever, influenza, and other infectious diseases (ARB 2003). There are no specific statutory or regulatory requirements relating to molds and indoor air quality required by any federal or state agencies (Davis 2001:1)

### Greenhouse Gas Emissions

With respect to GHGs, the U.S. Supreme Court ruled on April 2, 2007 that carbon dioxide ($CO_2$) is an air pollutant as defined under the CAA, and that EPA has the authority to regulate emissions of GHGs. However, no federal regulations or policies regarding GHG emissions are applicable to the proposed project at the time of writing.

## STATE PLANS, POLICIES, REGULATIONS, AND LAWS

### Criteria Air Pollutants

ARB is the agency responsible for coordination and oversight of state and local air pollution control programs in California and for implementing the California Clean Air Act (CCAA). The CCAA, which was adopted in 1988, requires ARB to establish California ambient air quality standards (CAAQS) (Table 4.1-1). ARB has established CAAQS for sulfates, hydrogen sulfide, vinyl chloride, visibility-reducing particulate matter, and the above-mentioned criteria air pollutants. In most cases the CAAQS are more stringent than the NAAQS. Differences in the standards are generally explained by the health effects studies considered during the standard-setting process and the interpretation of the studies. In addition, the CAAQS incorporate a margin of safety to protect sensitive individuals.

The CCAA requires that all local air districts in the state endeavor to achieve and maintain the CAAQS by the earliest practical date. The act specifies that local air districts should focus particular attention on reducing the emissions from transportation and areawide emission sources, and provides districts with the authority to regulate indirect sources.

Other ARB responsibilities include overseeing local air district compliance with federal and state laws, approving local air quality plans, submitting State Implementation Plans to EPA, monitoring air quality, determining and updating area designations and maps, and setting emissions standards for new mobile sources, consumer products, small utility engines, off-road vehicles, and fuels.

Ambient air quality in a given area depends on the quantities of pollutants emitted within the area, transport of pollutants to and from surrounding areas, local and regional meteorological conditions, as well as the surrounding topography of the area. Air quality is described by the concentration of various pollutants in the atmosphere. Units of concentration are generally expressed as a volume mixing ratio (i.e., parts per million or micrograms per cubic meter). Monitoring of criteria air pollutant concentrations is conducted through regular air sampling at monitoring stations distributed throughout each air basin. These data are used to identify areas of the state that are regularly exceeding air quality standards and determine attainment status.

The CCAA requires ARB to establish state criteria, which provide the basis for designating areas of California as attainment, nonattainment, nonattainment-transitional, or unclassified with respect to the CAAQS.

### Toxic Air Contaminants

TACs in California are regulated primarily through the Tanner Air Toxics Act (Assembly Bill [AB] 1807 [Statutes of 1983]) and the Air Toxics Hot Spots Information and Assessment Act of 1987 (AB 2588 [Statutes of 1987]). AB 1807 sets forth a formal procedure for ARB to designate substances as TACs. This includes research, public participation, and scientific peer review before ARB can designate a substance as a TAC. ARB has identified more than 21 TACs to date and has adopted EPA's list of HAPs as TACs. Most recently, diesel particulate matter (diesel PM) was added to the ARB list of TACs.

Once a TAC is identified, ARB adopts an airborne toxics control measure for sources that emit that particular TAC. If there is a safe threshold for a substance at which there is no toxic effect, the control measure must reduce exposure below that threshold. If there is no safe threshold, the measure must incorporate BACT to minimize emissions.

The Hot Spots Act requires that existing facilities that emit toxic substances above a specified level prepare an inventory of toxic emissions, prepare a risk assessment if emissions are significant, notify the public of significant risk levels, and prepare and implement risk reduction measures.

### Mold

#### *Toxic Mold Protection Act of 2001*

The Toxic Mold Protection Act (Senate Bill [SB] 732 [2001]) directs DPH, assisted by a task force of volunteer stakeholders, to undertake a series of complex tasks. These include determining the feasibility of adopting permissible exposure limits for indoor molds and the development of new standards or guidelines to:

- assess the health threat posed by the presence of indoor molds,
- determine valid methods for fungal sampling and identification,
- provide practical guidance for mold removal and abatement of water intrusion,

- disclose the presence of mold growth in real property at rental or sale, and
- assess the need for standards for mold assessment and remediation professionals.

However, the implementation of this statute depends on the provision of funding to accomplish these tasks. No funding has been provided by the state, and DPH has been soliciting donations from the public to raise the needed funding. Given the state budget situation and the current economic situation, it is unlikely that progress will be made on the implementation of this law in the near future.

The State of California does not have any regulations or thresholds that pertain to mold. In response to increasing queries with regard to mold toxicity, the DPH Indoor Air Quality Program has developed a Web site that includes a variety of documents related to this issue. This Web site includes a document specific to residential exposure titled "Mold in My Home: What Do I Do?" (DHS [now known as DPH] 2001).

The Occupational Health Branch of California Department of Health Services (OHB) is mandated to review new and emerging occupational hazards and propose new regulations to the California Division of Occupational Safety and Health (Cal/OSHA). As a result of a proposal by the OHB, Cal/OSHA is looking at adding molds to the sanitation standard for office buildings and workspaces (Davis 2001). OHB has created a "Molds in the Indoor Workplace" handout that addresses these concerns (DPH 2008).

### Greenhouse Gas Emissions

Various statewide and local initiatives to reduce the state's contribution to GHG emissions have raised awareness that, even though the various contributors to and consequences of global climate change are not yet fully understood, global climate change is under way, and a real potential exists for severe adverse environmental, social, and economic effects in the long term. Because every nation emits GHGs and therefore makes an incremental cumulative contribution to global climate change, cooperation on a global scale will be required to reduce the rate of GHG emissions to a level that can help to slow or stop the human-caused increase in average global temperatures and associated changes in climatic conditions. State law on the subject of climate change includes Executive Order S-3-05 and AB 32 (2006), which mandate statewide GHG emission reduction targets, and SB 97 (2007), which acknowledges that climate change is a prominent environmental issue that requires analysis under the California Environmental Quality Act (CEQA).

## LOCAL PLANS, POLICIES, REGULATIONS, AND ORDINANCES

### Criteria Air Pollutants

The 35 local air districts (e.g., Sacramento Metropolitan Air Quality Management District, San Joaquin Valley Air Pollution Control District) in California seek to improve air quality conditions at the local and regional level through comprehensive programs of planning, regulation, enforcement, technical innovation, and promotion of the understanding of air quality issues. Air districts prepare plans and programs for the attainment of ambient air quality standards, adopt and enforce rules and regulations, issue permits for stationary sources, inspect stationary sources, respond to citizen complaints, monitor ambient air quality and meteorological conditions, and implement other programs and regulations required by the CAA, CAAA, and CCAA.

### Toxic Air Contaminants

At the local level, air pollution control or management districts may adopt and enforce ARB control measures for TACs. Under district rules, all sources that possess the potential to emit TACs are required to obtain permits from the appropriate district. Permits may be granted to these operations if they are constructed and operated in accordance with applicable regulations, including new-source-review standards and airborne toxics control measures. Districts prioritize TAC-emitting stationary sources based on the quantity and toxicity of the TAC emissions and the proximity of the facilities to sensitive receptors.

Sources that require a permit are analyzed in a health risk assessment based on their potential to emit toxics. If it is determined that the project would emit toxics in excess of an applicable threshold, sources have to implement the best available control technology for TACs (T-BACT) to reduce emissions. If a source cannot reduce the risk below the threshold of significance even after T-BACT has been implemented, the district will deny the permit. This helps to prevent new sources of TACs and reduces emissions from existing older sources by requiring them to apply new technology with respect to TACs when retrofitting. It is important to note that the air quality permitting process applies to stationary sources; properties that are exposed to elevated levels of nonstationary-type sources of TACs and the nonstationary-type sources themselves (e.g., on-road vehicles, fugitive and areawide sources) are not subject to air quality permits. Furthermore, for feasibility and practicality reasons, mobile sources (e.g., cars, trucks,) are not required to implement T-BACT, even if they have the potential to expose adjacent properties to elevated levels of TACs. Rather, emissions controls on such sources (e.g., vehicles) are subject to regulations implemented on the federal and state levels.

#### Greenhouse Gases

No regional or local policies, regulations, or laws specifically pertain to GHG emissions associated with the proposed project.

## 4.1.2 EXISTING SETTING

The project area is the entire state of California. The ambient concentrations of air pollutants at any given location are determined by the amount of emissions from pollutant sources and the atmosphere’s ability to transport and dilute such emissions. Natural factors that affect transport and dilution are terrain, wind, atmospheric stability, and the presence of sunlight. Therefore, existing air quality conditions in the area are determined by such natural factors as topography, meteorology, and climate, in addition to the amount of emissions from existing air pollutant sources, as discussed separately below.

### TOPOGRAPHY, METEOROLOGY, AND CLIMATE

California’s climate varies widely, and includes Mediterranean, steppe, alpine, and desert climates. The Coast Range and Sierra Nevada act as barriers to the passage of air masses. Because of these barriers, and California’s proximity to the Pacific Ocean, summer weather in portions of the state is generally warmer than much of the country and is characterized by dry, sunny conditions with infrequent rainfall. In winter, proximity to the ocean, which retains a consistent annual temperature, keeps temperatures milder than would be expected at the same latitudes in other parts of the United States. During winter months, the state receives most of its annual rainfall.

### CURRENT AND PROJECTED USES OF PEX

Nearly 200 California cities and nearly 30 California counties have approved the use of PEX tubing in various cold and hot water plumbing (including potable water uses) applications in residential, commercial, and institutional buildings within their jurisdictions using the alternate materials provisions of the California Plumbing Code. In addition, at least three California cities (Palo Alto, Highland, and Santa Clarita) have adopted ordinances allowing the use of PEX tubing for a variety of hot and cold water applications. If the proposed regulations are adopted, use of PEX would be expected to increase in the cities and counties that allow PEX as an alternate material, and PEX would be used in city and county jurisdictions that do not currently allow its use.

The current market share of other allowable plumbing materials establishes the context for existing air quality conditions as they relate to the proposed project. As discussed in Chapter 3, “Description of the Proposed Project,” as of 2005 the market share for various plumbing materials for all types of uses (including hydronic radiant heating, and potable water distribution) in new homes in California was approximately 29% PEX, 13% chlorinated polyvinyl chloride (CPVC), 54% Copper, and 4% for all other materials. Other plumbing materials include galvanized steel and polyethylene (PE) with an aluminum layer (PEX-AL-PEX) (HCD 2006, Ash, pers.

comm., 2008). The most current data for PEX (2006) indicates that its share of the market for plumbing materials in new homes in California was approximately 37% (Ash, pers. comm., 2008). The net effect of adoption of the proposed regulations would probably be an increase in the use of PEX tubing, with a proportionate decease in the use of other piping materials—particularly copper.

### Criteria Air Pollutants

As described above, criteria air pollutants include ozone, CO, $NO_2$, $SO_2$, $PM_{10}$, $PM_{2.5}$, and lead. Ozone is a photochemical oxidant, a substance whose oxygen combines chemically with another substance in the presence of sunlight. Hydrocarbons are organic gases that are formed solely of hydrogen and carbon. There are several subsets of organic gases including volatile organic compounds (VOCs) and reactive organic gases (ROGs). Certain VOCs are considered ROGs. ROGs and oxides of nitrogen ($NO_X$) are emitted primarily by mobile sources and stationary combustion equipment. Another source of hydrocarbons is evaporation from petroleum fuels, adhesives, solvents, dry cleaning solutions, paint, primer, and cement. ROG emissions combine with $NO_X$ to form ozone. ROG and $NO_X$ are therefore ozone precursors. Adhesives and solvents can evaporate and react with other chemicals to form ozone.

### Toxic Air Contaminants

Concentrations of TACs are also used as indicators of ambient-air-quality conditions. A TAC is defined as an air pollutant that may cause or contribute to an increase in mortality or in serious illness, or that may pose a hazard to human health. TACs are usually present in minute quantities in the ambient air; however, their high toxicity or health risk may pose a threat to public health even at low concentrations.

According to the 2007 edition of the *California Almanac of Emissions and Air Quality* (ARB 2007), the majority of the estimated health risk from TACs can be attributed to relatively few compounds, the most important being diesel PM. Diesel PM differs from other TACs in that it is not a single substance, but rather a complex mixture of hundreds of substances. In addition to diesel PM, the TACs for which data are available that pose the greatest existing ambient risk in California are benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, para-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene. Of these 10 TACs, diesel PM poses the greatest health risk. Overall, levels of most TACs, except for para-dichlorobenzene and formaldehyde, have decreased since 1990 (ARB 2007:1–34, 5-1 through 5-45).

During installation and repair of copper tubing (the dominant material in water pipe use in California) the soldering process releases toxic and carcinogenic smoke and vapors into the atmosphere. A study measuring organic vapors generated during soldering of copper tubing demonstrated that the vapors contain the following chemicals, known to be present on ARB's TAC Identification List: chlormethane; vinyl chloride; chloroethane; carbon disulfide; isopropyl alcohol; methlyene chloride; hexane; vinyl acetate; 2-butanone; benzene; 1,2 dichlorethane; trichloroethylene; 1,4-dioxane; toluene; 4-methyl-2-pentanone; tetrachlorethylene; ethyl benzene; chlorobenzene; m/p-xylene; o-xylene; styrene; and benzyl chloride (ARB 2008b, HCD 2006). Though the amount of these chemicals emitted into the atmosphere during the copper soldering process could not be quantified in this study, it provides a basis for the potential air quality effects from copper tubing installation under existing conditions. The study also showed that $PM_{10}$, a criteria air pollutant, was emitted into the atmosphere (Research Triangle Park Laboratories 2006, as cited in HCD 2006:34–35).

### Plastic Tubing Incineration Hazards

The amount of plastic piping in structures is relatively small compared to the amount of other combustible construction materials and furnishings present in structures. In the event of a fire, plastic piping combustion products are not emitted quickly after the start of a fire because plastic piping is installed behind walls. Testing and field data indicate that gases emitted from plastic piping are no more toxic than other common building and furnishing materials found in structures (PM Engineer 2003). As noted in a letter submitted by the California Department of Forestry's, Office of the Fire Marshal (Reinertson, pers. comm., 2006:1), the existence of fire stopping materials, other requirements currently contained in the California Building Standards Code, and 2006

Uniform Plumbing Code provisions adopted (Walls, pers. comm., 2008) in the 2007 California Building Standards Code all mitigate the fire spread hazard associated with PEX. Further, the fire marshal stated that the quantity of PEX materials is relatively insignificant when compared to all the other materials within the building (Reinertson, pers. comm., 2006).

### Mold

Failure of any type of plumbing materials can lead to moisture buildup in structures. If the failure goes unnoticed for an extended period of time in a poorly ventilated area of the structure, the potential exists for biological agents including molds to grow and spread. Molds need both food and water to survive; since molds can digest most things, water is the factor that limits mold growth. Molds will often grow in damp or wet areas indoors. Common sites for indoor mold growth include bathroom tile, basement walls, areas around windows where moisture condenses, and near leaky water fountains or sinks. Common sources or causes of water or moisture problems include roof leaks, deferred maintenance, condensation associated with high humidity or cold spots in the building, localized flooding due to plumbing failures or heavy rains, slow leaks in plumbing fixtures, and malfunction or poor design of humidification systems. All molds have the potential to cause health effects. Molds produce allergens, irritants, and in some cases, toxins that may cause reactions in humans. The types and severity of symptoms depend, in part, on the types of mold present, the extent of an individual's exposure, the ages of the individuals, and their existing sensitivities or allergies (EPA 2007).

### Greenhouse Gases

Certain gases in the earth’s atmosphere, classified as GHGs, play a critical role in determining the earth’s surface temperature. Prominent GHGs contributing to the greenhouse effect are $CO_2$, methane, ozone, nitrous oxide, and fluorinated compounds. Climate change is defined as a change in the climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods. Human-caused emissions of these GHGs in excess of natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a trend of unnatural warming of the earth’s climate, known as global climate change (UNFCCC 2008). It is extremely unlikely that global climate change of the past 50 years can be explained without the contribution from human activities (IPCC 2007:10).

Climate change is a global problem. GHGs are global pollutants, unlike criteria air pollutants and TACs, which are pollutants of regional and local concern. Whereas pollutants with localized air quality effects have relatively short atmospheric lifetimes (about 1 day), GHGs have long atmospheric lifetimes (1 year to several thousand years). GHGs persist in the atmosphere for long enough time periods to be dispersed around the globe. Although the exact lifetime of any particular GHG molecule is dependent on multiple variables and cannot be pinpointed, it is understood that more $CO_2$ is emitted into the atmosphere than is sequestered by ocean uptake, vegetation, and other forms of sequestration.

Similarly, impacts of GHGs are borne globally, as opposed to localized air quality effects of criteria air pollutants and TACs. The direct impact of anthropogenic GHGs includes rising global average temperature. Indirect impacts of climate change include, but are not limited to, sea level rise, changes in precipitation patterns, effects on water supply, increased risk of flooding and wildfires, impacts on public health, and species extinction. The quantity of GHGs that it takes to ultimately result in climate change is not precisely known, but the quantity is enormous, and no single project would be expected to measurably contribute to a noticeable incremental change in the global average temperature, or to global, local, or micro climate. Thus, the nature of the impact of GHG emissions and climate change is inherently cumulative. See Chapter 5, “Cumulative Impacts,” for a discussion of GHG emissions and climate change as it relates to the proposed project.

## 4.1.3 ENVIRONMENTAL IMPACTS

This section describes the project's effects on air quality. The discussion includes the criteria for determining the level of significance of the effects and a description of the methods and assumptions used to conduct the analysis.

### ANALYSIS METHODOLOGY

As described in Chapter 3, "Description of the Proposed Project," the proposed project is a code change and the adoption of regulations, and not a typical site-specific development project. As such, the project does not have short-term construction or long-term operational phases or characteristics typical of most projects subject to review under CEQA. The increased use of PEX tubing in construction as a result of project approval would not generate an increase in criteria air pollutant emissions because the installation and repair of PEX tubing does not require the use adhesives or solvents (i.e., ozone precursors) and does not require soldering (a source of $PM_{10}$ emissions ). Thus, this impact analysis will focus on potential for increased emissions of TACs associated with PEX production and usage, potential for indoor air quality impacts, and potential health hazards associated with the release of chemicals from PEX incineration. The proposed project's potential for increased GHG emissions is discussed in Chapter 5, "Cumulative Impacts."

### THRESHOLDS OF SIGNIFICANCE

For purposes of this analysis, the following applicable thresholds of significance were used to determine whether implementing the proposed project would result in a significant impact related to air quality:

- conflict with or obstruct implementation of the applicable air quality plan,
- violation of any air quality standard or substantial contribution to an existing or projected air quality violation,
- result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard, or
- exposure of sensitive receptors to substantial pollutant (including mold) concentrations.

No air district or other regulatory agency in California has identified a significance threshold for GHG emissions generated by a proposed project, or a methodology for analyzing impacts related to GHG emissions or global climate change. By adoption of AB 32 and SB 97, however, the State of California has established GHG reduction targets and has determined that GHG emissions as they relate to global climate change are a source of adverse environmental impacts in California. Although AB 32 did not amend CEQA, the legislation does include language identifying the various environmental problems in California caused by global warming (Health & Safety Code, Section 38501[a]). SB 97, in contrast, will result in amendments to the State CEQA Guidelines. SB 97 directs the Office of Planning and Research to draft guidelines to assist public agencies in the assessment and mitigation of GHGs. Although such guidance is not yet available, this environmental impact report addresses the issue in Chapter 5, "Cumulative Impacts."

### IMPACT ANALYSIS

Because installation and repair of PEX tubing would not require the use of adhesives or solvents (i.e., ROGs), would not require soldering (which is a source of $PM_{10}$), and PEX tubing is not manufactured in the state of California, the project would not increase emissions of ozone precursors (e.g., ROGs and oxides of nitrogen), lead, sulfur oxides, CO, or PM. Thus, this impact analysis does not focus on the project's potential to increase emissions of criteria air pollutants or precursors, and these pollutants will not be discussed further.

IMPACT 4.1-1 *Air Quality—Exposure of Sensitive Receptors to Toxic Air Contaminants. Because manufacture of PEX tubing occurs out of state and is subject to EPA and local air quality rules and regulations, and installation does not require use of adhesives or solvents, neither the manufacture nor installation of PEX tubing would result in an increased risk of exposure of sensitive receptors to TAC emissions. Therefore, this impact is **less than significant**.*

The exposure of sensitive receptors to TAC emissions from the production of PEX and construction-related activities is discussed separately below.

### *Production and Manufacture*

PEX tubing is not currently produced in the state of California. It is also not produced in the states of Washington, Oregon, Nevada, Arizona, or in Baja, Mexico (Taber, pers comm., 2008). Industrial facilities, such as chemical plants and manufacturing plants where PEX is currently produced in the United States are required by federal measures to reduce emissions and to obtain air pollution permits to ensure compliance with the CAA (EPA 2008). The proposed project may increase PEX tubing demand and production, resulting in the emission of hydrocarbons. Air pollutant emissions from PEX production facilities are regulated, and compliance with the federal CAA and state and local permit processes would ensure that emissions from PEX manufacturing facilities would be within acceptable limits. No additional information on emissions associated with PEX manufacturing can be provided because after careful research and review of available documents and information, detailed air pollutant emissions information associated with PEX manufacturing could not be obtained. The proposed project would not result in exposure of sensitive receptors in California to excessive pollutant concentrations, and would not result in an increase in stationary-source emissions in California. Any potential increase in stationary-source emissions in another state would be controlled by the EPA and would be subject to EPA and local permitting processes. Thus, this impact would be **less than significant**.

### *Short-Term Construction*

Construction activities associated with PEX tubing installation would not require any change from business as usual. Specifically, the proposed project would not result in an increased construction work force or labor hours needed to install tubing, nor would the proposed project result in greater quantities of on-site construction equipment. In addition, PEX tubing weighs less than copper tubing. For example, three-quarter-inch PEX tubing is 2.9 to 5.7 times lighter than an equal length of the various weights of copper tubing (Church, pers. comm., 2007). Therefore, given the light weight of PEX compared to copper, less fuel would be required to truck the tubing to the construction site and may result in a reduction of $PM_{10}$ and other trucking-related emissions. Emissions of air pollutants attributable to construction worker commute and construction equipment exhaust would not differ from existing conditions. To the extent that PEX would be used in place of copper tubing, this would eliminate the TAC and $PM_{10}$ emissions associated with the soldering process during installation.
This impact would be **beneficial**.

## MITIGATION MEASURES

No mitigation measures are necessary because the impact is less than significant.

IMPACT 4.1-2 *Air Quality—Exposure of Sensitive Receptors to Biological Agents Including Mold. PEX tubing failure and flooding could result in the buildup of moisture in structures and the growth and spread of biological agents including mold. Because PEX tubing could prematurely fail and could lead to moisture buildup in structures, exposing sensitive receptors to mold, this impact is **potentially significant**.*

As discussed in Impact 4.2-3 (see Section 4.2, "Public Health and Hazards"), a potential exists for chlorinated potable water in continuously recirculating systems to cause PEX tubing to prematurely fail if it has not been tested for use in such a system. Premature failure of PEX tubing could lead to moisture buildup in structures. If the failure goes unnoticed for an extended period of time in a poorly ventilated area of the structure, the potential exists for biological agents to grow and spread. Biological agents including bacteria, viruses, and fungi (e.g., molds) can cause allergic reactions; asthma; eye, nose, and throat irritation; and humidifier fever, influenza, and other infectious diseases (ARB 2003). Because PEX tubing could prematurely fail and could lead to moisture buildup in structures, exposing sensitive receptors to mold, this impact is **potentially significant**.

### MITIGATION MEASURES

Mitigation Measure 4.1-2: Exposure of Sensitive Receptors to Biological Agents Including Mold.

The California Building Standards Commission shall implement Mitigation Measure 4.2-3, as described in Section 4.2, "Public Health and Hazards," to avoid the potential for a significant increase exposure of sensitive receptors to mold. Implementation of this mitigation measure would reduce this impact to a **less than significant** level.

| | |
|---|---|
| IMPACT 4.1-3 | *Air Quality—Exposure of the Public or Emergency Personnel to Toxic Products of Combustion from PEX Incineration. Incineration of PEX tubing would not increase health risks to the public or emergency personnel because other plastics and materials in buildings, including materials and products made from wood and other organic fibers, also produce toxic products of combustion hazardous to the health of humans, and the quantity of PEX tubing is relatively insignificant when compared to all the other materials within a building. Gases emitted from plastic tubing are no more toxic than other common building and furnishing materials found in structures. In addition, structure fire would be considered an anomaly and not part of the baseline under CEQA. Therefore, this impact is less than significant.* |

Upon incineration in the event of a structure fire, PEX would release chemicals considered TACs, which could then pose a health hazard to the public or emergency personnel. After careful research and review of available documents and information, no specific data characterizing the emissions from the incineration of PEX tubing were identified. PEX is made of PE, and is a member of the polyolefin family of polymers. These polymers include normal PE, HDPE, PP, and PB. PE is an extremely versatile plastic and is a commonly found chemical in the home. HDPE is used for shampoo, detergent, and bleach bottles. Other uses for PE include cold-water pipes, vapor barriers in buildings, insulation, flexible foam, artificial hip joints, and household items such as laundry baskets and water buckets (Li 1996).

As noted by the fire marshal of the California Department of Forestry and Fire Protection, the expanded use of all types of plastics as well as other building materials and contents and the products of combustion generated by these materials in the fire environment creates an increasingly toxic environment within a burning structure. However, common materials and products made from wood and other organic fibers also produce toxic products of combustion hazardous to the health of humans. The quantity of PEX tubing is relatively insignificant when compared to all the other materials within a typical structure. Therefore, the added toxic products of combustion generated by PEX tubing in a fire would be comparatively minor (Reinertson, pers. comm., 2006), and testing and field data indicate that gases emitted from plastic piping are no more toxic than other common building and furnishing materials found in structures (PM Engineer 2003). Furthermore, the proposed project would not result in an increased risk of structure fire, which would only occur in extremely rare and infrequent situations. In the event of a structure fire, a large portion of materials that would be incinerated (e.g., carpeting, electronics, insulation, wood) would present similar health risk. The extent to which PEX would contribute to this risk would be minor in comparison to the total. Most importantly, structure fire would be considered an anomaly and not part of the baseline under CEQA, and thus, this type of analysis would be beyond the scope of these administrative proceedings. Therefore, impacts associated with toxic emissions from incineration of PEX as a result of a structure fire are **less than significant**.

### MITIGATION MEASURES

No mitigation measures are necessary because the impact is less than significant.

## 4.1.4 SIGNIFICANT AND UNAVOIDABLE IMPACTS

Because all potentially significant and significant impacts would be reduced to a less-than-significant level with the implementation of mitigation, no air quality impacts would be significant and unavoidable.

# 4.2 PUBLIC HEALTH AND HAZARDS

This section evaluates potential public health and hazards impacts associated with the proposed project, specifically impacts related to biofilm, fire hazards, and mold. Public health and hazards impacts related to the potential degradation of pipes from oxygen and chloramines is not discussed because a review of existing studies did not provide evidence to support claims made regarding these potential hazards. No studies were available that tested for degradation of PEX by these materials and there is no reason to believe that these materials would degrade PEX at a rate that is any faster than they would degrade other piping materials. Background data and analyses are based primarily on technical studies submitted by the California Department of Housing and Community Development, the Plastic Pipe and Fittings Association, and the Coalition for Safe Building Materials. Particularly relevant studies and references are included in the appendices of this draft environmental impact report (DEIR); all studies and references used in this DEIR are available for review at the Department of General Services address on page 2-4 of this DEIR. This analysis is limited to plumbing applications of PEX for use in a variety of hot and cold water (including potable water irrigation and wastewater) applications for commercial, residential, industrial, and institutional building projects. Water quality impacts associated with the proposed project are considered in Section 4.4, "Water Quality."

## 4.2.1 REGULATORY SETTING

### FEDERAL PLANS, POLICIES, REGULATIONS, AND LAWS

#### Occupational Safety and Health Administration

The U.S. Congress created the federal Occupational Safety and Health Administration (OSHA) under the Occupational Safety and Health Act in 1970 (Title 29, U.S. Code, Section 651 et seq. [29 USC 651 et seq.]). The act was adopted in response to concerns for worker safety and encourages states to develop and operate their own job safety and health programs, which OSHA approves and monitors (29 USC 667). OSHA has approved the California state plan (OSHA 2008).

The *OSHA Technical Manual*, Section III, Chapter 2 (Davis 2001) refers to molds as a potential indoor air quality concern. This document suggests guidelines to employers on how to respond to employee complaints regarding indoor air quality, including recommendations for removal of offending organisms. Molds are one of several air contaminants mentioned as possible causes of building-related illnesses.

### STATE PLANS, POLICIES, REGULATIONS, AND LAWS

State of California regulations related to the potential health and safety hazards of using PEX are described below. No State of California regulations pertain specifically to biofilm. However the federal and state Safe Drinking Water Acts address biofilm indirectly through the regulation of bacteria and the requirement for disinfection of most drinking water. For a discussion of drinking water disinfection requirements, please see Section 4.4, "Water Quality."

#### California Occupational Safety and Health Administration

The California Department of Industrial Relations enforces regulations governing workplace safety and health through the California Occupational Safety and Health Assessment Program (Cal/OSHA Program). Cal/OSHA sets regulations for acceptable exposure levels for airborne substances that can be harmful to workers. Some of these substances are present in adhesives solvents commonly used in construction and required to join chlorinated polyvinyl chloride (CPVC) fittings. Installation of PEX does not require (and PEX is not compatible with) solvents or glues. Therefore, it does not generate airborne substances in the workplace that would be subject to these regulations.

The Occupational Health Branch of the Department of Public Health (OHB) is mandated to review new and emerging occupational hazards and propose new regulations to the California Division of Occupational Safety and Health (Cal/OSHA). As a result of a proposal by the OHB, Cal/OSHA is considering adding standards for molds to the sanitation standard for office buildings and workspaces (Davis 2001). OHB has created a "Molds in the Indoor Workplace" handout, which addresses these concerns (DPH 2008).

### Toxic Mold Protection Act of 2001

The Toxic Mold Protection Act directs the Department of Health Services (now known as the Department of Public Health [DPH]), assisted by a task force of volunteer stakeholders, to undertake a series of tasks. These include determining the feasibility of adopting permissible exposure limits for indoor molds and the development of new standards or guidelines to:

- assess the health threat posed by the presence of indoor molds,
- determine valid methods for fungal sampling and identification,
- provide practical guidance for mold removal and abatement of water intrusion,
- disclose the presence of mold growth in real property at rental or sale, and
- assess the need for standards for mold assessment and remediation professionals.

However, the implementation of this statute depends on the provision of funding to accomplish these tasks. No funding has been provided by the state, and DPH has been soliciting donations from the public to raise the needed funding. Given the state budget situation and the current economic climate, it is unlikely that progress will be made on the implementation of this law in the near future.

The State of California does not have any regulations or thresholds that pertain to mold. In response to increasing queries about mold toxicity, the DPH Indoor Air Quality Program has developed a Web site that includes a variety of documents related to this issue. This section includes a document specific to residential exposure titled "Mold in My Home: What Do I Do?" (DHS 2001).

### California Plumbing Code Firestop Standards (Title 24 of the California Code of Regulations, Part 5)

The California Plumbing Code (CPC) specifies standards for firestop protection and standards for plumbing that penetrates firestop structures. Firestops are structures within buildings that slow the spread of fire. A very common firestop structure consists of 2- x 4-inch horizontal wood blocking that is installed between vertical 2- x 4-inch studs inside wood-framed structures. The fire and heat retarding standard is normally expressed as the time that the structure may be exposed to specific fire conditions before allowing fire to spread or ambient temperatures to increase to a specified level. CPC Section 1501.0 et seq. specifies firestop standards for plumbing and plumbing assemblies that penetrate firestops.

Section 1505.2 specifies that when plumbing penetrates a firestop structure, the firestop capability of the structure shall be restored to its original rating. This means that the firestop structure through which the plumbing is installed must be able to withstand and retard the spread of fire for at least the same period of time at the same temperature as it would without the plumbing. This requires the use of a "penetration firestop system": an assembly of materials that surrounds the plumbing penetration of the firestop structure and is designed to retain the firestopping capabilities (Section 1504.1). The CPC specifies that these penetration firestop systems for plumbing structures meet standards of the American Society for Testing Materials Standard (ASTM), specifically the ASTM E 119 or E 814 tests for firestopping capability.

These tests are specific procedures for testing the firestopping capabilities of penetration firestop systems (or plumbing penetrations) by exposing the systems to fire and incineration. The CPC specifies that plumbing penetrations of floors must meet specific standards related to temperature retardation (T rating) and other penetrations must meet specific standards related to fire retardation (F rating). A T rating is the time period that the firestop and plumbing penetration takes to allow an increase in 325°F above ambient temperatures on one side of the structure when exposed to heat on the other side of the structure. Plumbing penetrations of floors must have a T rating of at least 1 hour (Section 1505.3). An F rating is the time period that the firestop and plumbing penetration can limit the spread of fire, under exposure to flame and heat. Plumbing penetrations must have an F rating of at least 1 hour (Section 1505.3).

## 4.2.2 EXISTING SETTING

The statewide use of PEX tubing is currently allowed in California for hydronic heating systems and potable water in manufactured homes. Additionally, nearly 200 California cities and nearly 30 California counties have approved the use of PEX tubing in various cold and hot water plumbing (including potable water irrigation and wastewater) applications in residential, commercial, and institutional buildings within their jurisdictions using the Alternate Materials, Designs, Tests and Methods of Construction provisions of the CPC (CPC 108.7 et seq.). In addition, at least three California cities (Palo Alto, Highland, and Santa Clarita) have adopted ordinances allowing the use of PEX tubing for a variety of cold and hot water applications. (Adoption by ordinance precludes the need for case-by-case assessment of PEX uses.) If the proposed regulations are adopted, increased use of PEX is anticipated in the cities and counties that currently allow PEX as an alternate material, and use of PEX is expected in the city and county jurisdictions that do not currently allow it.

The current market share of other allowable plumbing materials establishes the context for existing hazards and public health concerns as they relate to the proposed project. As discussed in Chapter 3, “Description of the Proposed Project,” as of 2005 the market share for various plumbing materials for all types of uses (including hydronic radiant heating, and potable water distribution) in new homes in California was 29% PEX, 13% CPVC, 54% copper, and 4% for all other materials. Other plumbing materials include galvanized steel and cross-linked polyethylene with an aluminum layer (PEX-AL-PEX). (HCD 2006; Ash, pers. comm., 2008.) The most current data for PEX (2006) indicates that its share of the market for plumbing materials in new homes in California was 37% (Ash, pers. comm., 2008). The net effect of adoption of the proposed regulations would probably be an increase in the use of PEX tubing, with a proportionate decrease in the use of other piping materials, particularly copper because of copper corrosion issues arising from using chloramines for disinfecting drinking water.

PEX is an approved pipe material in the Uniform Plumbing Code (UPC), International Plumbing Code (Church, pers. comm., 2007:1), and the International Residential Code (Brown, pers. comm., 2007:1). These plumbing codes require PEX piping to be third-party certified to applicable standards for various performance criteria, depending on the type of use. Testing standards related to oxidative/chlorine resistance of PEX are listed below in Table 4.2-1.

ASTM is an independent, nonprofit, standards-writing organization. It issues standards in many diverse technical disciplines. ASTM is the forum for a majority of standards in the United States, especially those related to plastic materials and products testing (NSF International 2008). NSF International, a nonprofit organization, is the most widely recognized agency for a listing of plumbing products in the United States. In a publicly searchable database, NSF indicates (i.e. lists) which products by which manufactures are certified under which standards. (See http://www.nsf.org/Certified/PwsComponents.) Following are details on the various NSF International and ASTM standards that may be applicable to PEX.

**NSF/ANSI Standard 14:** This standard establishes minimum requirements for physical performance, health effects, quality assurance, marking (labeling), quality control testing, test frequencies at each production location, and record keeping requirements for plastic piping components and related materials. Under NSF/ANSI Standard 14, PEX tubing must be marked (i.e., labeled) at intervals of no more than 5 feet and must include:

- the manufacturer’s name or trademark;
- the testing standards to which it conforms;
- tube size;
- material designation code (i.e., PEX0006);

- pressure/temperature rating(s);
- Standard Dimension Ratio (SDR) (a formula that represents the pipe diameter divided by the wall thickness);
- if the tubing is for potable water, a laboratory seal or mark attesting to suitability for potable water; and
- ASTM fittings designations approved for use by the tubing manufacturer.

This standard also requires that materials used for pressure pipes, including PEX, meet a minimum 50-year, long-term strength requirement (Brown, pers. comm., 2007:2).

**Table 4.2-1**
**Testing Standards Related to Oxidative or Chlorine Resistance of PEX**

| Testing Standard | Title | Purpose | Service Life |
|---|---|---|---|
| **NSF International/American National Standards Institute (ANSI)** | | | |
| NSF/ANSI 14 | Plastic Pipe System Components and Related Materials | Physical strength, performance, health effects | 50 years |
| NSF P171 CL-T (or TD)[1] | Chlorine Resistance of Plastic Piping Materials | Chlorine resistance | 80 years (40 years with 0.5 design factor) |
| NSF P171 CL-R[2] | Chlorine Resistance of Plastic Piping Materials | Chlorine resistance | 80 years (40 year with 0.5 design factor) |
| **American Society for Testing Materials (ASTM)** | | | |
| ASTM F2023[3] | Standard Test Method for Evaluating the Oxidative Resistance of Cross-linked Polyethylene (PEX) Tubing and Systems for Hot Chlorinated Water | Oxidative resistance | 50 years (25 year if 0.5 design factor is applied) |
| ASTM F876 | Standard Specification for Cross-linked Polyethylene (PEX) Tubing | Product design, pressure strength, oxidative (chlorine) stability, environmental stress cracking | 50 years |
| ASTM F877 | Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems | Product design, pressure strength, thermocycling resistance, bend strength | |

Notes:
[1] Applies to traditional domestic hot and cold potable water applications (assumes 25% hot water and 75% room temperature water)
[2] Applies to 100% hot water recirculation
[3] Applies to traditional domestic hot and cold potable water applications (assumes 25% hot water and 75% room temperature water)
Source: Data compiled by EDAW in 2008

**NSF P171 CL-TD:** This standard refers to systems used to transport traditional domestic potable water. Most plumbing systems are traditional domestic (Theilen, pers. comm., 2008). In these systems, the hot water pipes are exposed to hot water only when the tap is turned on and hot water is flowing through the system. The rest of the time, they are at room temperature (NSF International 1999).

**NSF P171 CL-R:** This standard refers to continuous circulation of hot chlorinated water. This refers to systems in which hot water is recirculated through the hot water side of the plumbing system (NSF International 1999). However, in general, these systems are rare and are mainly found in the commercial sector (e.g., hotels) or in some large homes (Theilen, pers. comm., 2008).

**ASTM F2023-05, *Standard Test Method for Evaluating the Oxidative Resistance of Cross-linked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water:*** This was most recently updated in 2005. This test procedure is designed to provide an estimate of the life expectancy of a hot-water plumbing pipe when used at a water temperature of 140°F and a pressure of 80 pounds per square inch (psi) (NAHB Research Center 2006:9).

This standard lists the requirements and test methods for evaluating PEX tubing in long-term contact with hot, chlorinated water (Brown, pers. comm., 2007:3).

**ASTM F876, *Standard Specification for Cross-linked Polyethylene (PEX) Tubing*:** This requires all PEX tubing to be evaluated against ASTM F2023. To ensure the reliability of PEX piping systems in hot chlorinated water applications, the PEX product standard specification ASTM F876 requires that all PEX intended for use with potable water have a minimum extrapolated lifetime of 50 years when tested in accordance with test method ASTM F2023 (NAHB Research Center 2006:9).

**ASTM F877, *Specification for Cross-linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems*:** This requires a pressurized flow-through test system, typical test pressures, test-fluid characteristics, failure type, and data analysis (ASTM 2008a). Additionally, PEX piping systems use fittings that also must comply with ASTM standards, and are made from brass, copper, or high-temperature engineered polymers that are chlorine resistant (NAHB Research Center 2006:9).

## 4.2.3 ENVIRONMENTAL IMPACTS

### ANALYSIS METHODOLOGY

This analysis is based on a review and evaluation of existing information and reports documenting studies and conclusions from scientists, tubing manufacturers, and agencies. Relevant materials and information sources include:

- documents published by federal, state, and local agencies;
- consultation with California construction and plumbing industry experts;
- consultation with knowledgeable individuals of state and local agencies; and
- other documents and information contained in the project administrative record.

### THRESHOLDS OF SIGNIFICANCE

For purposes of this analysis, the following applicable thresholds of significance were used to determine whether implementing the proposed project would result in a significant impact related to public health and hazards. The project would result in a significant impact if it would result in:

- a substantial increase in the public health risks associated with biofilm,
- substantial increase in fire hazard,
- substantial premature tubing failure and flooding that would lead to widespread incidences of mold infestation associated with significant health risks, or
- substantial safety hazards for plumbers.

### IMPACT ANALYSIS

As described in Chapter 3, “Description of Proposed Project,” the proposed project is a code change, adoption of regulations, and not a typical site-specific development project. As such, the project would not involve routine transport, use, or disposal of hazardous materials, and specific considerations of the initial study checklist (i.e., location near a public airport or school, interference with emergency plans) would not apply. These issues are not discussed further.

The potential for leaching of or permeation by toxic chemicals is assessed in Section 4.4, “Water Quality.”

IMPACT 4.2-1 **Public Health and Hazards—Potential Risk of Contact with Pathogens from Biofilm Growth.** *Because biofilm could potentially harbor pathogenic bacteria such as* Legionella*, higher amounts of biofilm could lead to increased risk of human contact with pathogenic bacteria. All piping materials exhibit some biofilm formation (Chaudhuri, pers. comm., 2008). Although formation of biofilm is initially slower in copper tubing compared to PEX tubing, no substantial difference exists over longer periods. No direct quantitative correlation exists between measurements of biofilm and growth of* Legionella*. Therefore, increased biofilm growth does not correspond to higher amounts of* Legionella *bacteria, and the use of PEX would not lead to increased risk of human contact with pathogenic bacteria. Therefore, this is considered a* ***less-than-significant*** *impact.*

A concern exists that PEX promotes the growth of biofilm to a greater degree than other types of plumbing piping and tubing, such as copper. Because biofilm could potentially harbor pathogenic bacteria such as *Legionella*, higher amounts of biofilm could potentially lead to increased risk of human contact with pathogenic bacteria. *Legionella pneumonophila* causes Legionnaire's disease. Some studies show that PEX displayed the strongest biofilm formation and the strongest promotion of the growth of *Legionella* bacteria and that copper piping inhibits the growth of *Legionella* bacteria (Coalition for Safe Building Materials 2005:41–42).

Biofilms are a collection of microorganisms surrounded by the slime they secrete, attached to either an inert or living surface (Edstrom Industries 2008). Biofilms are common in nature. They are usually found on solid substrates submerged in or exposed to some aqueous solution. Biofilms may form on any surface exposed to bacteria and some amount of water. A biofilm can be formed by a single bacterial species, but more often biofilms consist of many species of bacteria, as well as fungi, algae, protozoa, debris, and corrosion products. Bacteria commonly have mechanisms by which they adhere to surfaces and to each other. In residential and commercial environments, biofilms can develop on the interiors of pipes and lead to clogs and corrosion. MNB Momba et al. 2000 define the term biofilm as a layer of microorganisms in an aquatic environment held together in a polymetric matrix attached to a substratum such as pipes or tubing. The matrix consists of organic polymers that are produced and excreted by the biofilm microorganisms. Biofilms are sometimes formed as continuous, evenly distributed layers but are often patchy in appearance. Biofilms in water distribution systems are thin, reaching a maximum thickness of perhaps a few hundred micrometers (MNB Momba et al. 2000). Biofilm is analyzed in studies as the number of total bacteria, heterotrophic plate counts (an indicator of bacteria cell counts), or the concentration of adenosine triphosphate per surface area (which correlates with direct bacterial cell counts) of biofilm (Markku et al. 2005). Biofilms are a public health concern because they could potentially harbor pathogens, such as *Legionella pneumophila*, which causes Legionnaire's disease.

Although some studies show greater formation of biofilm in PEX tubing as compared to copper (Veenendaal and van der Kooij 1999) these results were reported after a relatively short duration (less than 250 days). Because plumbing pipes or tubing installed in buildings are generally used for many years, the studies evaluating biofilm formation over longer time periods (between 250 days and 2 years) provide more relevant results than studies evaluating biofilm formation over shorter time periods. Dick van der Kooij of KIWA Research presented the results of a study where bacteria were allowed to grow for an additional 300 days beyond the duration of the original study (described above) at a *Legionella* congress in Amsterdam (2006). The longer duration study showed that *Legionella* growth was approximately the same in copper as in PEX. The study authors hypothesize that the amount of *Legionella* on copper is low in the beginning because of the release of copper ions, which have a toxic effect on the *Legionella* bacteria. However, over a period of time a biofilm layer is created that may serve as a barrier, thus preventing or lessening the release of copper ions and ultimately reducing the toxic effect on the Legionella.

Perhaps more importantly from a public health perspective, the studies indicate that there does not appear to be a direct connection between quantities of biofilm and *Legionella*, nor does *Legionella* occur at higher rates in PEX than in copper. One of the conclusions of the study conducted by Veenendaal and van der Kooj (1999), discussed above, was that though there was greater formation of biofilm in PEX during the 200-day testing period, there was no direct relationship between biofilm formation and growth of *Legionella* and measurements of *Legionella* growth in copper and PEX were not substantially different after 200 days. Van der Kooij et al. (2005) studied biofilm formation and growth of *Legionella* with pipes of copper, stainless steel and PEX. The authors found that

*Legionella* concentrations in water and biofilms were at the same levels for all materials after 2 years. Therefore, increased biofilm growth does not correspond to higher amounts of *Legionella* bacteria, and the use of PEX would not lead to increased risk of human contact with pathogenic bacteria. Therefore, this is considered a **less-than-significant** impact.

### Mitigation Measure

No mitigation measures are necessary because the impact is less than significant.

IMPACT 4.2-2 **Public Health and Hazards—Increased Risk of Fire Ignition and Fire Spread.** *PEX tubing carrying water within a building is not likely to be flammable. Conformance to CPC requirements and applicable design and installation guidelines, including the use of approved firestop material, would reduce any potential fire hazards–related depressurization of plastic tubing during structural fires. Additionally, plastic tubing is not an efficient heat conductor and structure fires generally do not exceed the temperature necessary to cause plastic tubing to ignite, thus the use of PEX would not increase fire hazards. Therefore, this impact is* ***less than significant.***

Comments have been made that when filled with water, PEX is not likely to be flammable, but when exposed to heat during a fire, the PEX may rapidly rupture. PEX rupture may drain or depressurize the plumbing system and create openings in wall studs that may encourage the spread of fire (Coalition for Safe Building Materials 2005:44). Concerns exist that the use of PEX tubing poses a significant fire threat because of the highly flammable characteristics of PEX (Coalition for Safe Building Materials 2005:44).

Both copper and plastic tubing are often inserted perpendicularly through 2- x 4-inch wall studs. Heat generated during structural fires may cause PEX to burst or melt. The burst or melted tubing may result in an opening between the tubing and the 2 x 4 (Exhibit 4.2-1). Thus, the wall stud would no longer be sealed. This type of opening could depressurize the space and may encourage the spread of fire.

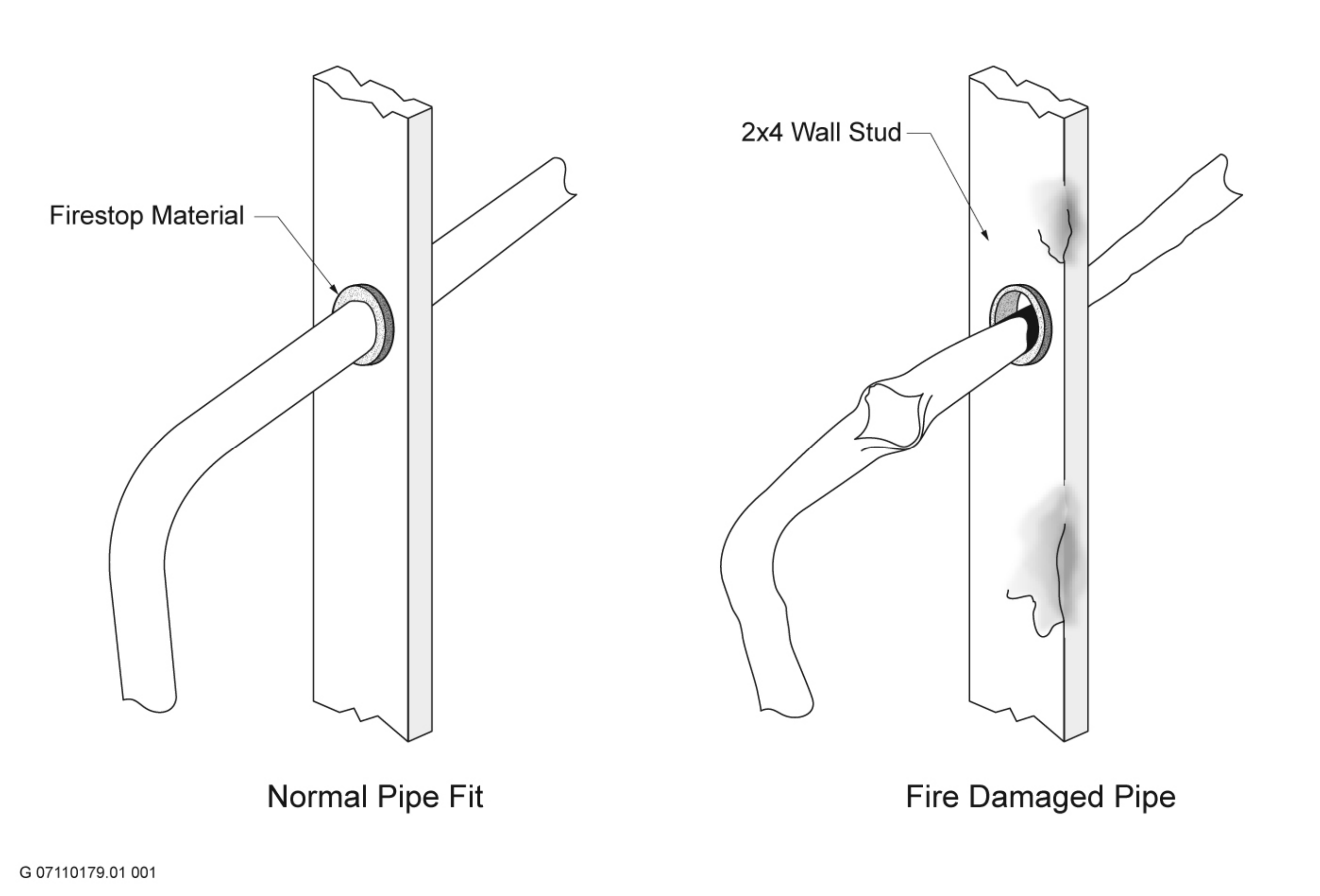
PEX has characteristics similar to other plastic pipes that have been studied and tested more rigorously than PEX. Fire ignition is the means by which things catch on fire. Plastic pipes and tubing have low thermal conductivity, so fire ignition or a threat of fire spread from high temperatures or heat conduction along plastic pipes that penetrate wood wall studs is highly unlikely (PM Engineer 2003:2–3). Additionally, a database review of fires related to the use of plastic pipes during the last 40 to 50 years in the United States concluded that the use of plastic pipe presents no unique fire hazard and does not demonstrate unique issues concerning fire ignition or the spread of fire (Zicherman 2000:6). While temperatures in wall cavities may cause plastic to melt during the early stages of a structural fire, the temperatures are still far too low to cause the plastic to catch on fire (PM Engineer 2003:3). In addition, no studies or evidence demonstrates that depressurized pipes are a substantial fire hazard. Because PEX is not flammable and does not encourage fire spread, its use would not result in increased fire hazard.

CPC Chapter 15, Section 1506.3, specifies that [pipe] “[p]enetrations shall be protected by an approved penetration firestop system installed as tested in accordance with ASTM E 119 or ASTM E 814.” ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, provides a relative measure of the fire-test-response of comparable building elements under certain fire exposure conditions (ASTM 2008b). ASTM E 814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops*, is applicable to through-penetration firestops of various materials and construction (Table 4.2-2). Firestops are intended for use in openings in fire-resistive walls and floors that are evaluated in accordance with ASTM E 119 (ASTM 2008b).

**Table 4.2-2**
**Testing Standards Related to Firestop Materials**

| Testing Standard | Title | Purpose |
|---|---|---|
| ASTM E 814 | Standard Test Method for Fire Tests of Through-Penetration Fire Stops | Firestop compatibility |
| ASTM E 119 | Standard Test Methods for Fire Tests of Building Construction and Materials | Firestop compatibility |

Source: Data compiled by EDAW in 2008.




Source: Data compiled by EDAW in 2008

**Heat Damaged Plastic Pipe** **Exhibit 4.2-1**

CPC specifies that plumbing penetrations of floors must have a T rating of at least 1 hour (Section 1505.3), and other penetrations shall have an F rating of at least 1 hour (Section 1505.3). An F rating is based on flame occurrence on the unexposed surface, while the T rating is based on the temperature rise and flame occurrence on the unexposed side of the fire stop. Both of these ASTMs are used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions associated with the T and F ratings (ASTM 2008a).Therefore, PEX products that are certified under these ASTMs are in compliance with CPC Section 1506.3.

Conformance to the applicable design and installation guidelines, such as using the approved firestop material, can prevent any potential for fire hazards related to depressurization of plastic pipes (PM Engineer 2003:4). Eight studies in PM Engineer 2003 discuss fire endurance tests involving cavity wall constructions containing plastic pipes. Each test demonstrated that successful installations can be made using generic firestop materials for smaller diameter pipes and approved penetration firestop systems for larger diameter pipes. These studies cited tests that were conducted at federal and university labs and third-party testing facilities. The use of plastic plumbing does not reduce fire endurance of firestop material provided that the pipe penetrations are properly designed, sized, and sealed (Zicherman 2000:4). The use of approved firestop material would either prevent pipe rupture or actively fill the ruptured pipe space within the wall stud. Therefore the use of plastic pipes, including PEX, is not likely to increase fire ignition and fire spread.

As noted in a letter submitted by the California Department of Forestry, Office of the Fire Marshal (Reinertson, pers. comm., 2006:1), the development of firestop materials, requirements currently in the California Building Standards Code, and 2006 UPC provisions adopted in the 2007 California Building Standards Code (Walls, pers.

comm., 2008) all mitigate the fire spread hazard associated with PEX. The letter from the California State Fire Marshal confirms that the adopted Uniform Building Code provisions and other applicable requirements mitigate the possibility of fire spread associated with the use of PEX. The use and proper installation of approved firestop materials would prevent pipe rupture. Therefore, the use of PEX would not result in increased fire hazard.

For discussion of PEX compatibility with certain firestop compounds, please see the discussion below in Impact 4.2-3.

The Plastic Pipe and Fittings Association has tested and compiled information on the firestop capabilities of various plumbing penetrations of walls and other structures (Ackerman, Cen, and Wilging 2004). This document provides diagrams of tested configurations for plumbing penetrations of firestop structures and the T and F ratings for those structures. These tests show possible configurations for floor penetrations using PEX that have both T and F ratings of 2 hours. They also show wall penetrations that have T and F ratings of 1 hour. As demonstrated by the above described configurations, with appropriate fittings and structural penetrations PEX can meet the firestop standards adopted in California. Sample firestop assemblies and system configurations for floors and walls can be found in Appendix D (Ackerman, Cen, and Wilging 2004). Because PEX meets the firestop standards specified in the California Administrative Code, Section 1501.1 et seq., use of PEX would not increase fire hazards or encourage fire spread. Therefore, this impact is considered **less than significant.**

### Mitigation Measure

No mitigation measures are necessary because the impact is less than significant.

| | |
|---|---|
| IMPACT 4.2-3 | Public Health and Hazards—Risk of Premature or Unexpected PEX Failure and Flooding Potentially Increasing the Incidence of Mold. *UV light, certain firestop materials, and chlorine can contribute to failure of PEX. However, PEX manufacturers add UV resistant material into the pipe and include instructions to avoid UV degradation, which decreases the impact of UV light on PEX. Numerous firestop materials are compatible with PEX and appropriately used firestop materials do not degrade PEX. Finally, the possibility of PEX failure from chlorine degradation would be confined to jurisdictions that have not yet switched to chloramine disinfection and specifically to projects in those jurisdictions that use continuously recirculating, hot, chlorinated water systems. Without attack from chloramines, aggressive water, or soils, copper pipes are known to outlast the buildings in which they are installed. However, no data are available that show the actual life expectancy of CPVC and PEX; data from the NSF and ASTM testing methods estimate life expectancy, but are based on extrapolation. Extrapolation means to project, extend, or expand known data or experience into an area not known or experienced to arrive at a usually conjectural knowledge of the unknown area. In other words, extrapolation means to predict by projecting past experience or known data: in this case, predicting the time to failure under extremely harsh conditions. Though extrapolation can provide reasonably reliable predictions, some measure of uncertainly is involved. Because the ASTM standard—unlike the NSF standard—simply does not assume that some systems will operate with continuously recirculating hot chlorinated water or incorporate a design factor, the level of certainty provided by ASTM F2023 is not as great as that provided by NSF P171. Because PEX tubing within jurisdictions that use chlorine and continuously recirculating, hot, chlorinated water systems may have shorter product lives than copper, CPVC, or PEX in traditional domestic applications and this consideration is not accounted for in the current ASTM F2023, this is considered a* ***potentially significant*** *impact.* |

PEX could prematurely rupture from interactions with oxidizers (i.e., UV light and chlorine) and firestop materials (materials used to safeguard PEX from fires) (Coalition for Safe Building Materials 2005:33). These interactions eventually cause polymer chains (combined molecules that contain repeating structural units) in PEX tubing to break down, which may result in loss of strength, brittleness, and ultimately premature mechanical failure (Coalition for Safe Building Materials 2005:33).

Ruptures could cause serious water damage to homes (Coalition for Safe Building Materials 2005:33). Water damage from leaking or ruptured pipes may cause mold to grow, which is often not visible. Mold may be hidden in places such as inside walls, around pipes, and inside ductwork. Other possible locations of hidden mold include the back side of drywall, wallpaper, or paneling; the top side of ceiling tiles; or the underside of carpets and pads. Molds can cause health problems because they produce allergens, irritants, and in some cases, potentially toxic substances (mycotoxins). Inhaling or touching mold or mold spores may cause allergic reactions in sensitive individuals. Allergic responses include symptoms such as sneezing, runny nose, red eyes, and skin rash (dermatitis). Allergic reactions to mold are common and can be immediate or delayed. Molds may also cause asthma attacks in people with asthma who are allergic to mold (EPA 2008).

PEX has been used for many years in many geographic locations. Like many products, issues have arisen that point to problems with, for example, specific lots (batches) or methods of installation. For example, PEX failures are the subject of a number of lawsuits in Washington State (Coalition for Safe Building Materials 2005:34). The PEX failures in Washington State refer to a specific resin source that failed in several applications, such as distribution, hydronic applications, and where firestop materials were once in contact with the tubing. These failures, however, were attributed to a specific defective lot. All of the failed PEX tubing was produced by a single manufacturer, which is no longer in business (Church, pers. comm., 2007:5). Such failures are not representative of the entire PEX industry. Another current lawsuit concerns a number of failures related to the use of Zurn manufactured PEX tubing and the brass the fittings manufactured by Zurn for use with Zurn PEX. This lawsuit is ongoing. According to the plaintiffs, the pipe failures appear to be related to either a design or manufacturing defect of the fittings. Therefore, the Zurn suit is not relevant to the general issue of potential PEX failure.

### *PEX Failure from Ultraviolet Light*

UV light may rapidly deplete the stabilizers in PEX, which would dramatically reduce its lifespan (Coalition for Safe Building Materials 2005:36). PEX may be left exposed at construction work sites or laid under slab at the edges of the building where it could be exposed to sunlight during portions of the day, left exposed during pipe installation, slab pour, framing, and sheathing. In tract housing this can add up to a month or more of exposure (Coalition for Safe Building Materials 2005:36). Excessive radiation is known to be detrimental to some plastic pipes. Accordingly, PEX is specially packaged and specific instructions are provided by the manufacturers as to acceptable exposures based on the type, color, and/or composition of the pipe (Church, pers. comm., 2007:3). Although PEX includes additives to prevent UV degradation, PEX should not be stored for extended periods outdoors exposed to the sun. Precautions must be taken after the pipe is removed from the original container. Each PEX manufacturer publishes a maximum recommended UV exposure limit that generally does not exceed a total accumulated time of 60 days, based on the UV resistance of that pipe (NAHB Research Center 2006:10). Most PEX manufacturers add UV resistant material into the pipe and include instructions to avoid UV degradation. Because of this, and because it is considered reasonable and feasible to comply with manufacturers instructions, substantial incidence of mold resulting from premature failure of PEX from UV degradation is considered an anomalous condition and a **less-than-significant** impact.

### *PEX Failure from Firestop Materials*

Certain firestop materials used to safeguard PEX during fires are thought to accelerate degradation of PEX material, which may lead to pipe rupture (Coalition for Safe Building Materials 2005:35). Specifically, certain intumescent firestop materials may accelerate the loss of stabilizers in PEX, which could lead to pipe failure (Coalition for Safe Building Materials 2005:35). An intumescent is a substance that swells from heat exposure. This fire-resistant material restores the fire-resistance ratings of rated wall and/or floor assemblies by filling any openings, thus impeding the spread of fire through the opening.

Many firestop materials are designed to be compatible with PEX and some are not. Compatible firestops include, but are not limited to, gypsum-based caulking (Coalition for Safe Building Materials 2005:35), Triple S Intumescent Sealant, LCI Intumescent Sealant, and Pensil Silicone Sealant (Specified Technologies, Inc. 2008). Most firestop materials are labeled to indicate whether they are compatible with PEX. Certain solvents are incompatible with PEX tubing and some firestops contain these solvents. Uponor, as well as most (if not all) manufacturers have a list of recommended firestop materials for use with PEX tubing. In all cases, manufacturers provide listings to ASTM E 814 (standard for penetrations of fire-rated walls) that specify a particular firestop material (Houle, pers. comm., 2008). To comply with the California Building Code requirements, the installation of the PEX tubing through the wall must comply with the listing for the particular assembly that will specify the type of firestop used. All of the firestop manufacturers that Uponor and other manufacturers recommend have the necessary E 814 listings with PEX tubing. (Houle, pers. comm., 2008). Most PEX manufacturer's installation guides also indicate that oil-based firestop materials should not be used and that in the event that the firestop materials are not labeled regarding compatibility with PEX, the PEX should be wrapped with aluminum foil before using the firestop materials to avoid contact of the firestop materials with the PEX. In addition to firestop materials, certain assemblies of materials and fittings are available that create a firestop installation. Because many readily available firestop materials are compatible with PEX, and the information about which materials are appropriate to use with PEX is readily available, the potential impact of substantial incidences of mold caused by premature failure of PEX as a result of use inappropriate firestopping materials is considered **less than significant**.

### *PEX Failure from Chlorine*

Three standards are used for testing the chlorine resistance of PEX used to distribute hot and cold water: ASTM F2023, NSF P171-Cl-TD (for traditional domestic use), and NSF P 171-CL-R (for continuously recirulating uses). Concerns have been expressed that certification in accordance with the ASTM standard does not actually ensure the 50-year or 90-year service of PEX products that has been claimed by some manufacturers and third-party testers of PEX because of the extrapolation of data from a short testing period to a long service life period is inherently uncertain (Coalition for Safe Building Materials 2005:33). Additionally, concerns have been raised that the ASTM standard does not consider the possibility that some systems use continuously recirculating hot chlorinated water (Boyher, pers. comm., 2007), which may cause more rapid breakdown of PEX. This means that the certified life expectancy of 50 years under the ASTM standard is not actually applicable to PEX that is used to continuously recirculate hot chlorinated water (Boyher, pers. comm., 2007).

The chlorine in potable water has been reported to reduce the lifetime of PEX. Test lifetimes of PEX are significantly shorter when chlorine is introduced at levels as low as .01 milligrams per liter (mg/L) (Jana Laboratories Inc. n.d.). All of the testing methods involve testing water under pressure in a flowing system. This continuous flow ensures that a constant controlled level of chlorine is present in the water throughout testing. Samples are tested under aggressive (i.e., hot and high chlorine content) water quality conditions that are intended to represent worst-case scenarios that might be seen in service life. Elevated temperatures are used to accelerate failures. Expected service life is extrapolated from time to failure under these tests, which take place over a 36- to 62-day period.

The NSF standards were developed first and are not industry consensus standards. ASTM was developed later and is an industry consensus standard. (Vibien, pers. comm., 2008.) An industry consensus standard is a voluntary consensus standard developed by representatives of sectors that have an interest in the use of the standard. These sectors can include producers, users, and those having a general interest (representatives of government and academia), as well as ultimate consumers. The actual physical testing methods are the same for ASTM and NSF standards. Testing is done under conditions of continuously flowing hot water at 203°, 221°, and 239°F. The test results are then used in a regression analysis to extrapolate to water temperatures of 140°F (hot water) and 73°F (cold water). ASTM has a lifetime requirement of 50 years, and NSF 171-Cl-TD has a lifetime requirement of 80 years, both assuming 25% hot water exposure and 75% cold water exposure. An equation called Miner's rule is applied to estimate pipe lifetimes based on time to failure under a variety of test conditions assuming the 25% hot water and 75% cold water exposures. However, NSF 171-Cl-R for continuously recirculating systems has a lifetime requirement of 80 years assuming 100% hot water. NSF then adds a .5 design factor for both of its standards to account for the unexpectedly harsh service conditions and certifies a product lifetime for PEX of 40 years (Boyher, pers. comm., 2007). If this conservative design factor were applied under the ASTM standard, then the certified product lifetime for PEX tubing that is tested only under the ASTM standard would be 25 years. The

ASTM standard was not designed to consider a 100% continuously recirculating hot water system and thus does not make an assumption of 100% hot water and then base its extrapolation on that assumption. ATSM is currently considering adopting a standard that addresses 100% hot water for recirculating systems, but currently the NSF 171-Cl-R is the only standard that does so.

Chemicals like chlorine, bromine, and ozone are all oxidizers. It is their ability to oxidize—that is, to "steal" electrons from other substances—that makes them effective water sanitizers, because in altering the chemical makeup of bacteria, they kill them. In the process of oxidizing, all of these compounds are reduced, so they lose their ability to further oxidize.

The term oxidative reduction potential (ORP) is used to describe the ability of the oxidizers in the water to keep the water free from contaminants. ORP is measured in units of electrical energy called millivolts (mV), or one-one thousandth of a volt, and is the small voltage generated when metal is placed in water in the presence of oxidizing and reducing agents. These voltages give us an indication of the ability of the oxidizers in the water to keep the water free from contaminants.

The test conditions for both ASTM and NSF require that the test fluid has a minimum ORP of 825 mV. Because the oxidizing capacity of chlorine varies widely depending on the pH of the water, test fluid is produced by third-party test laboratories that typically use water purified using reverse osmosis with a free chlorine concentration of 4.3 +/- 0.3 parts per million (ppm) (4.3 mg/L) and a pH of 6.8 +/- 0.2, resulting in an ORP of 825 mV or higher (NAHB Research Center 2006:9). This represents a very aggressive water quality, which gives conservative results.

A recent trend in California is a move from chlorine to chloramines for water supply disinfection (EPA 2007). Approximately one-third of all public water systems in the United States now use chloramines for disinfection (EPA 2007). The possibility of PEX failure from chlorine degradation would be limited to jurisdictions that have not yet switched to chloramine disinfection and projects in those jurisdictions that use continuously recirculating, hot, chlorinated water systems. Without attack from chlorine or aggressive water, copper pipes are known to outlast the buildings in which they are installed. However, no data are available that show the actual life expectancy of CPVC and PEX; data from the NSF P171 and ASTM F2023 testing methods estimate life expectancy, but are based on extrapolation. CPVC and PEX have simply not been in use in the United States long enough to provide data on performance over time (Thielen, pers. comm., 2008).

### Polybutylene in Chlorinated Water

There are contrasting claims about whether or not polybutylene (PB) and PEX are related and demonstrate similar properties. Both are from the polyolefin family, but PB is derived from butanol and PEX is derived from ethylene. The key concern with PB was that it was subject to attack from chlorine and loss of antioxidants, which resulted in mechanical failure. Some have expressed concern that PEX could be subject to the same kind of failure. It is true that both PB and PEX are members of the polyolefin family, but that does not necessarily mean that PEX will automatically behave similarly to PB (Chaudhuri, pers. comm., 2008).

Lundback et al. (2006) studied PB pipes in chlorinated water and the lifetime was assessed as a function of temperature and chlorine content. The authors found that the lifetime of PEX shortened in chlorinated water substantially, even at relatively low chlorine contents of 0.5 ppm. Further increases in the chlorine content of the water only moderately shortened further the lifetime of PEX. The decrease in the antioxidant concentration was independent of the chlorine concentration in the range of 0.5–1.5 ppm.

No independent peer-reviewed journal articles were located that compared PB and PEX failure under the same conditions; therefore, it is not possible to determine based on literature review whether PEX could fail in a similar manner to PB. Tests are available, however, to determine the product life of PEX given chlorine usage in domestic hot water systems. Because it is uncertain whether PEX could behave in a similar fashion to PB (though indications from use of PEX so far is that PEX is more resistant to oxidation), it is important to test PEX under the chlorine conditions that would be used in California to determine whether it passes the test.

### High-Density Polyethylene in Chlorinated Water

Almost all PEX is made from high-density polyethylene (HDPE). PEX begins as HDPE but contains cross-linked bonds that create a polymer structure. Hassinen et al. (2004) studied the deterioration of HDPE pipes exposed to chlorinated water at elevated temperatures. The authors found that embedded stabilizers were rapidly consumed by the action of chlorinated water. Extensive polymer degradation was confined to the immediate surface of the unprotected inner wall material. This study was conducted on HDPE, not PEX; therefore it is not possible to apply these results directly to PEX. In his analysis report to the California Building Commission (Hoffmann 2005), Hoffman states "Since PEX products will be more stable and resistant to degradation, we can conclude that the development of a similar affected porous surface layer should be substantially less than that observed for HDPE." However, he does not provide any research or other substantiation for this claim. Therefore, it is uncertain whether PEX could behave in a similar fashion to HDPE.

## *Conclusion*

UV light, certain firestop materials, and chlorine can contribute to failure of PEX. However, PEX manufacturers add UV resistant material into the pipe and include instructions to avoid UV degradation, which decreases the impact of UV light on PEX. Numerous firestop materials are compatible with PEX and are made known by the industry, and if these compatible materials are used, firestop materials do not degrade PEX. Finally, the potential for premature PEX failure from chlorine degradation would be confined to jurisdictions that have not yet switched to chloramine disinfection and specifically to projects in those jurisdictions that use continuously recirculating, hot, chlorinated water systems. Without attack from chloramines or aggressive water or soils, copper pipes are known to last a long time, often longer than the buildings in which they are installed. However, no data are available that show the actual life expectancy of CPVC and PEX; NSF and ASTM testing methods estimate life expectancy, but are based on extrapolation. Extrapolation means to project, extend, or expand known data or experience into an area not known or experienced so as to arrive at a usually conjectural knowledge of the unknown area. In other words, extrapolation means to predict by projecting past experience or known data: in this case, projecting the time to failure under extremely harsh conditions. Though extrapolation can provide reasonably reliable predictions, some measure of uncertainly is involved. Given the uncertainties involved, erring on the side of caution would avoid a potentially significant impact, however speculative that potential impact may be. Because the ASTM standard does not consider systems with continuously recirculating hot chlorinated water or incorporate a design factor, while the NSF test does, the level of certainty provided by ASTM F2023 is not as great as that provided by NSF P171. Because PEX tubing used in continuously recirculating, hot chlorinated water systems within jurisdictions that use chlorine may have shorter product lives that copper, CPVC, or PEX in traditional domestic applications, this is considered a potentially significant impact.

### Mitigation Measure 4.2-1: Risk of Premature or Unexpected PEX Failure and Flooding Potentially Increasing the Incidence of Mold.

The Building Standards Commission will adopt regulatory language requiring that when installing PEX for recirculating systems in jurisdictions that use chlorine for disinfection, the PEX tubing must be certified using the NSF P171 CL-R standard or a yet-to-be adopted equally rigorous standard that assumes 100% continuously recirculating chlorinated hot water, would ensure a conservative product lifetime of 40 years and is approved by the Building Standards Commission for testing PEX for continuously recirculating hot chlorinated water. Because the NSF P171 CL-R standard assumes 100% hot water and includes a safety factor to ensure a conservative product lifetime of 40 years, this would reduce the risk of premature or unexpected PEX failure to **less than significant**.

IMPACT 4.2-4 **Public Health and Hazards—Increased Safety Hazards for Plumbers.** *PEX tubing does not require the use of solvents, glues, or open flames during installation. Also, PEX tubing is lighter than metal pipes. Therefore, there are no health hazards for plumbers and this impact is* ***less than significant****.*

The installation of PEX tubing uses fittings that do not require solvents or glues, which means it does not generate airborne substances in the workplace that would cause harm to plumbers. Additionally, no soldering or welding is required to install PEX tubing, which means there is no risk of burns or fires during installation. Further, PEX tubing weighs less than metal pipes, which reduces potential for health and safety issues related to physical injuries. Because the use of PEX would not result in safety hazards for plumbers, this is considered a **less-than-significant** impact.

### Mitigation Measure

No mitigation measures are necessary because the impact is less than significant.

## 4.2.4 SIGNIFICANT AND UNAVOIDABLE

Because all potentially significant and significant impacts would be reduced to less than significant with the implementation of mitigation, no public health and hazards impacts would be significant and unavoidable.

# 4.3 SOLID WASTE

This section describes the existing solid waste setting for plastics and plastic plumbing tubing in California and analyzes potential solid waste impacts associated with implementation of the proposed project.

## 4.3.1 REGULATORY SETTING

### THE CALIFORNIA INTEGRATED WASTE MANAGEMENT ACT

The California Integrated Waste Management Act (CIWMA) (California Public Resources Code Section 40000 et seq.) is administered by the California Integrated Waste Management Board (CIWMB). CIWMA required cities and counties to reduce their solid waste stream by 50% by 2000 "through source reduction, recycling, and composting activities" (Section 41780). This requires cities and counties to divert by a variety of means a substantial portion of the waste stream that would otherwise go to landfills. The required quantity by which the city and county waste streams must be reduced is calculated by determining a "base year" (Section 40901) and then adjusting the projected total solid waste stream pursuant to the CIWMA (Sections 41780.1 and 41780.2). These standards create a floor of required waste reduction, which cities and counties are free to exceed in their waste diversion, recycling, composting and source reduction (Section 40901[n]).

## 4.3.2 EXISTING SETTING

### PEX USE IN NORTH AMERICA AND CALIFORNIA

In the United States and Canada, the current estimated use of various piping materials for residential potable water plumbing (one-half- to 2-inch diameter pipe) is approximately 53% copper, 30% chlorinated polyvinyl chloride (CPVC), and 17% all other materials (HCD 2006). In 2005, the market share for various plumbing materials for all types of uses (including hydronic radiant heating and potable water distribution) in new homes in California was approximately 54% copper, 13% CPVC, 29% PEX, and 4% all other materials (see Section 3.4.4, "Current and Projected Uses of PEX"). Other plumbing materials include galvanized steel and polyethylene with an aluminum layer (PEX-AL-PEX).

### PLASTICS IN CALIFORNIA

Since the 1950s, plastics have grown into a major industry. The unique characteristics of plastics (lightweight, durability, and formability) enable the material to be used in a variety of products. Plastics are widespread in packaging, furniture, appliances, automobiles, buildings, medical equipment, toys, and a wide variety of industrial and consumer goods. Manufacturers and consumers have widely embraced plastic products, ranging from plastic water bottles to toys to computers. The largest categories of plastic resin sales are packaging (26%), building and construction (22%), consumer and institutional (14%), and transportation (5%).

Plastics have displaced many other materials in our economy over the last several decades. Because plastics are lightweight, they reduce the tonnage of waste ultimately sent to landfills compared to other heavier materials (CIWMB 2003). However, as plastics are displacing heavier, less-flexible materials in packaging, building, transportation, and disposable products, the volume of disposed plastics is increasing almost as rapidly as production levels. As a result, plastics in the municipal solid waste stream continue to grow, and they are the fastest growing portion of the municipal waste stream. In 2000, plastics represented approximately 8.9% (by weight) and an estimated 17.8% (by volume) of the material disposed in California landfills (an estimated 3.4 million tons). Though lightweight, plastic is still the fifth-largest category of material by total weight in California's landfills. Plastic ranks as the second-largest category of waste by volume (behind paper) going into municipal landfills (CIWMB 2003).

Plastics production continues to far outpace plastics recycling. The plastics recycling rate has stagnated at a relatively low level for reasons described below, and plastic recycling quantities and rates remain lower than other materials such as steel, aluminum, glass, and paper. Plastics historically have been uneconomical to recycle without subsidies. Because plastics are lightweight and multiple plastic resin types require sorting, the cost of recycling plastics can be considerably higher than the scrap prices paid to recyclers. Average collection and processing costs have been reported to exceed scrap values by more than 2½ times (CIWMB 2003). In general, plastics are not as economical to recycle as other material types. Aluminum is the only material that is recycled more than it is disposed. The amount of plastics in landfills is increasing at a rapid rate, in part because—as a weight-based program—plastic recycling does not contribute significantly to meeting CIWMA waste diversion goals. Laws for plastic-recycled content have only been moderately successful, and the laws have relatively little affect on plastic recycling rates in California (CIWMB 2003).

In 2003, the CIWMB commissioned a “Statewide Waste Characterization Study” to better understand the residential, commercial, and self-hauled waste streams. Wastes were sorted and characterized according to 98 material types and 10 broad material classes, including 29 types of plastic. Plastic pipes and fittings are considered “other durable plastic items.” Durable plastic items are plastic items other than disposable package items and include plastics used in construction, furniture, and transportation industries. Examples include mop buckets, plastic outdoor furniture, plastic toys, and building materials such as house siding, window sashes, and frames. This material type also includes plastic dishes, cups, housings for electronics, fan blades, impact resistant cases (i.e., tool boxes and first aid boxes), and plastic pipes and fittings. Overall, the total amount of disposed (i.e., landfilled) solid waste in 2003 was approximately 40,235,328 tons, and construction and demolition debris represented about 21.7% by weight (approximately 8,732,000 tons) of that waste (CIWMB 2004).

In 2004, the CIWMB commissioned a study focused on only construction and demolition waste (including wastes from building or improvements to structures, and wastes from the razing or tearing down of structures). Durable plastic items represented 0.2% of the overall construction and demolition waste stream analyzed in the study (CIWMB 2006). Therefore, assuming plastic pipes and fittings represented 50% of all durable plastic items, and PEX tubing represented 29% of all plastic pipes and fittings in 2003, all types of PEX tubing (including PEX tubing for potable water and other uses such as hydronic heating systems) would represent up to 0.006% (29% of all plastic pipe in the construction and demolition waste stream) of the waste placed in landfills in 2003 (see Equation 4.3-1). This section assumes that the information in the 2003 and 2004 CIWMB studies would remain constant and reasonably estimates future disposal of construction and demolition waste and durable plastic items in the state.

**Equation 4.3-1.** Landfilled PEX Tubing in 2003

1. Solid Waste Disposed in California in 2003 = 40,235,328 tons
2. 40,235,328 x 0.217 = 8,732,074 x 0.002 = 17,464 tons durable plastic items
3. 17,464 tons durable plastic items x 0.5 = 8,732 tons plastic tubing x 0.29 = 2,532 tons PEX
4. 2,532 tons / 40,235,328 tons = 0.006% landfilled solid waste

## PLASTIC PIPE RECYCLING AND REUSE

Most recycled plastics in the United States are polyethylene terephthalate (PET) and high-density polyethylene (HDPE) containers, accounting for a little over one-half of national plastics recycling. Other categories of plastics recycled in substantial quantities are polypropylene battery casings; HDPE, low-density polyethylene, and linear low-density polyethylene stretchwrap and film; PET x-ray films; and polystyrene protective packaging (CIWMB 2003).

Plastic pipes, such as acrylonitrile butadiene styrene, HDPE, PEX, polypropylene, and polyvinyl chloride (PVC) and CPVC, are seldom recycled. PVC is marginally recyclable under some circumstances, and is considered a contaminant in most municipal recycling programs. The dominant end-of-life option for plastic pipes is disposal in either a landfill or incineration. PEX recycling is hampered by the cross-linking of the polyethylene molecules. Cross-linked plastics like PEX are known as “thermoset” plastics and cannot be remelted or remolded. This makes PEX very difficult to recycle. However, PEX can be ground down and used as filler in another material (Center for Environmental Health 2005:3,14–16). PEX manufacturers are pursuing markets for clean ground manufacturing and installation scrap and are selling it for other uses such as composite lumber (used in decking and fences), irrigation tubing, and filler in cement and asphalt. In addition, PEX manufacturers intend to develop markets for end-of-life PEX scrap (Houle, pers. comm., 2008). After careful research and review of available documents and information, additional specific information on markets for PEX scrap could not be obtained. From a recycling and reuse standpoint, PEX tubing is different than other plastic products because it can last 50 to 100 years in a structure (Church, pers. comm., 2007). Therefore, PEX tubing does not enter the waste stream as quickly as PET and HDPE containers, and most PEX tubing debris would not enter the construction and demolition waste stream until approximately 50 years after it is installed or the structure is demolished.

## 4.3.3 ENVIRONMENTAL IMPACTS

### ANALYSIS METHODOLOGY

This solid waste impact analysis is based on a review and evaluation of existing information and reports documenting statewide disposal of plastics and construction and demolition debris in California, including:

- documents published by federal, state, and local agencies;
- consultation with California construction and plumbing industry experts;
- consultation with appropriate state and local agencies; and
- other documents and information cited herein and contained in the project administrative record.

Solid waste impacts that would result from implementation of the proposed project were identified by comparing existing information on solid waste disposal against anticipated future rates for solid waste disposal associated with project implementation. The following analysis assumes that the project would change the estimated percentage use of various plumbing materials in California to 25% copper, 30% CPVC (similar to national market share), and 45% PEX. These assumptions are based on market share information for various plumbing materials provided by the National Association of Homebuilders and information from the California Department of Housing and Community Development (see Section 3.4.4, “Current and Projected Uses of PEX”). Because the net effect of adoption of the proposed PEX regulations would be an increase in the use of PEX tubing, with a proportionate decease in the use of other tubing materials (particularly copper), it is assumed that the estimated percentage use of PEX would increase from 29% to 45%, and copper would decrease from 54% to 25% because of the reduced labor costs associated with installation of PEX and because of corrosivity issues with copper piping resulting from the increased use of chloramines for drinking water disinfection.

In addition, this impact analysis considers the amount of PEX debris from statewide housing demolition and building permit data.

### THRESHOLDS OF SIGNIFICANCE

The thresholds for determining the significance of impacts for this analysis are based on the environmental checklist in Appendix G of the California Environmental Quality Act Guidelines. The proposed project would result in a significant impact on solid waste if it would result in:

- generation of solid waste beyond the permitted capacity of existing landfills; or
- violation of federal, state, or local statutes and regulations related to solid waste.

## IMPACT ANALYSIS

During the scoping meetings for this draft environmental impact report, some comments were made that water leaks associated with the failure of copper or other plumbing systems could damage structures and generate construction and demolition debris (including drywall, wood, and carpeting). After careful research and review of available documents and information, data on failure of copper tubing and construction and demolition debris associated with copper tubing failure could not be obtained. For example, the 2004 CIWMB construction and demolition debris study does not include information on the amount of construction and demolition debris associated with the failure of copper or other plumbing systems. Because data on failure of copper tubing and construction and demolition debris associated with copper tubing failure could not be obtained, this impact analysis does not consider this issue, and this issue will not be discussed further.

IMPACT 4.3-1 **Solid Waste—Increased Generation of Solid Waste.** *Although the proposed project would slightly increase the amount of scrap PEX generated for disposal (i.e., up to 0.03 % of the total solid waste annually sent to landfills statewide), the maximum amount of solid waste annually generated by the proposed project is not substantial in relation to the total amount of landfilled solid waste. In addition, PEX tubing could be diverted and sold for other uses, and there is no substantial evidence that the addition of PEX waste, in and of itself, would be sufficient to substantially consume landfill capacity or otherwise shorten the planned disposal life of any landfill. Therefore, this impact is considered* ***less than significant****.*

PEX tubing is currently used in California for potable water plumbing systems, water service lines, hydronic radiant heating systems, and is authorized for all uses in manufactured homes. Nearly 200 cities and 30 counties in the state have approved PEX tubing for hot and cold water (including potable water) applications in residential, commercial, and institutional buildings using alternate materials provisions (see Chapter 3, "Description of Proposed Project"). Implementation of the proposed project would increase the use of PEX tubing for potable water applications, with a proportionate decrease in the use of other piping materials (such as copper). It is assumed that the proposed project would increase the estimated percentage use of PEX tubing in California from approximately 29% to 45% because of the reduced labor costs associated with installation of PEX and because of corrosivity issues with copper piping resulting from the increased use of chloramines for drinking water disinfection (see Section 3.4.4, "Current and Projected Uses of PEX"). Proposed project implementation would also change the estimated percentage use of other types of plastic tubing (Table 4.3-1).

**Table 4.3-1**
**Current and Projected Plastic Tubing Market Share for New Single-Family Homes in California**

| Type of Plastic Tubing | 2005 Market Share in California (%)[1] | Projected Market Share in California if Project is Approved (%) | 2005 / Projected Share of Plastic Tubing Market[4] (%) |
|---|---|---|---|
| CPVC | 13 | 30[2] | 31/40 |
| PEX | <u>29</u> | <u>45[3]</u> | <u>69/60</u> |
| Total | 42 | 75 | 100/100 |

Notes:
CPVC = chlorinated polyvinyl chloride; PEX = cross-linked polyethylene.
[1] Although more current PEX market share data is available, the most current data on other types of plastic tubing available is from 2005. Therefore, this section relies of the 2005 data for purposes of this discussion.
[2] Based on market share increase estimated in the 2006 CPVC EIR.
[3] Estimated market share increase for purposes of this analysis (see "Analysis Methodology" in Section 4.3.3, "Environmental Impacts").
[4] Assumes two types of plastic tubing in California.
Sources: HCD 2006; Ash, pers. comm., 2008

Proposed project implementation would result in an increased volume of PEX tubing debris requiring disposal. PEX debris would be generated when PEX tubing is installed in a structure and when various types of buildings and structures containing PEX are demolished. The amount of debris generated during PEX installation is relatively small, consisting of remnant scraps, and the largest amount of PEX debris is generated when a structure is demolished and the entire plumbing system is removed and discarded. Therefore, it is assumed that any PEX tubing debris would be accounted for in the construction and demolition waste stream. Because it is anticipated that the market share for copper tubing in California will continue to fall, and plastic tubing market shares will continue to grow proportionately, it is anticipated that the amount of plastic tubing in the construction and demolition waste stream would increase. To account for this anticipated increase, it is assumed that plastic pipes and fittings would represent 100% of all durable plastic items in the future construction and demolition waste stream, and PEX tubing would represent 60% of all plastic pipes and fittings. Therefore, all types of PEX tubing (including PEX tubing for potable water and other uses such as hydronic heating systems) would represent up to 0.03% of the waste placed in landfills annually (see Equation 4.3-2). However, this number is a maximum estimate because a significant amount of the waste PEX tubing in the construction and demolition waste stream would come from nonpotable uses such as hydronic heating systems, for which PEX is already allowed. In addition, although PEX is not currently recyclable, some amount of PEX tubing could be diverted and sold for other uses such as composite lumber, irrigation tubing, or filler in cement and asphalt. Therefore, it is reasonable to assume that the PEX tubing would represent less than 0.03% of all landfilled waste.

**Equation 4.3-2.** Landfilled PEX Tubing with Proposed Project Implementation (As a Percentage of the Construction and Demolition Waste Stream)

1. Solid waste disposed in California in 2003 = 40,235,328 tons
2. 40,235,328 x 0.217 = 8,732,074 x 0.002 = 17,464 tons durable plastic items
3. 17,464 tons durable plastic items x 1 x 0.6 = 10,478 tons PEX tubing
4. 10,478 tons PEX tubing / 40,235,328 tons = 0.026% landfilled solid waste

The amount of PEX debris can also be estimated based on housing demolition and building permit data. As discussed above, PEX debris is generated when PEX is installed in a structure and when a structure containing PEX tubing is demolished. For a typical single-family residential PEX installation, the average amount of PEX tubing required is 500 feet. For a condo or apartment, the average amount of PEX tubing required is 300 feet per unit. This impact analysis assumes that all new and demolished housing units would require or include 500 feet of PEX tubing. However, this is a conservative number because some demolished and new housing would be classified as a condo or apartment. Such an installation would generate approximately 15 pounds of scrap PEX (Theilen, pers. comm., 2008; PPFA 2007). Approximately 7,359 housing units are demolished in California annually on average (HCD 2006:158; California Department of Finance 2006). Based on the projected market share for PEX in California, housing demolitions would generate approximately 108 tons of PEX debris (assuming 100 feet of PEX tubing weighs an average of 13 pounds [Houle, pers. comm., 2008]), new housing construction would generate approximately 3,729 tons, and all other construction and demolition would generate approximately 1,919 tons, for a total of 5,756 tons. Therefore, based on this method of estimation (i.e., [7,359 demolished housing units multiplied by 65 pounds of PEX per unit] plus [207,154 new housing units multiplied by 65 pounds of PEX per unit] plus [207,154 new housing units multiplied by 15 pounds of scrap PEX per unit] plus [50% of demolished plus new housing units] divided by the total amount of disposed waste [i.e., 40,235,328 tons]), annual demolition and construction debris would represent a maximum of approximately 0.01% of the waste placed in landfills annually (see Equation 4.3-3).

**Equation 4.3-3.** Landfilled PEX Tubing with Proposed Project Implementation (Based on Demolition and New Construction Data)

1. 7,359 housing units x 65 pounds PEX tubing per unit = 478,335 pounds x 0.45 = 108 tons
2. 207,154 new homes x 65 pounds PEX per unit = 6,733 tons x 0.45 = 3,030 tons
3. 207,154 new homes x 15 pounds PEX per unit = 1,554 tons x 0.45 = 699 tons
4. (108 tons + 3,030 tons + 699 tons) x 0.5 = 1,919 tons
5. 108 tons + 3,030 tons + 699 tons + 1,919 tons = 5,756 tons / 40,235,328 tons = 0.014%

Although the proposed project would slightly increase the amount of scrap PEX generated for disposal (i.e., a maximum of 0.03% of the total annual solid waste sent to landfills statewide), the maximum amount of solid waste annually generated by proposed project implementation is not substantial in relation to the total amount of landfilled solid waste (i.e., 40,235,328 tons). In addition, PEX tubing could be diverted and sold for other uses. Furthermore, beyond speculation, it is difficult to estimate exactly where or when PEX tubing would be disposed and what the capacity of various existing and future landfills throughout the state will be at the time of disposal, exactly to what extent it will be reused or recycled, or what the plastics disposal laws will be at that time. In any case, there is no substantial evidence that the addition of PEX waste, in and of itself, would be sufficient to substantially consume landfill capacity or otherwise shorten the planned disposal life of any landfill. Therefore, this impact is considered **less than significant**.

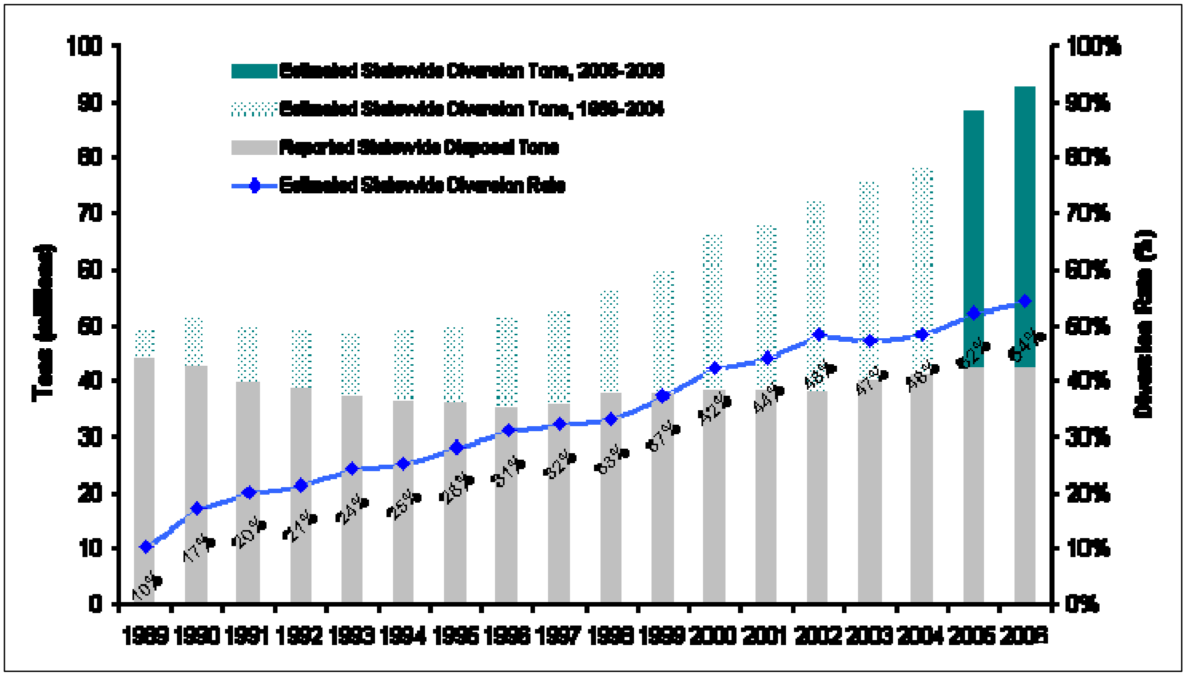
### MITIGATION MEASURES

No mitigation measures are necessary because the impact is less than significant.

IMPACT 4.3-2 Solid Waste—California Integrated Waste Management Act Compliance. *In 2005, California achieved a 52% waste diversion rate and increased the diversion rate to 54% in 2006. Assuming these trends continue into the future, California will continue to meet the 50% waste diversion rate as required by the CIWMA. Because the state of California is currently meeting the CIWMA diversion rate goal, the statewide diversion rate trend is upward, and implementation of the proposed project would not indirectly violate or cause noncompliance with the CIWMA, this impact is considered* ***less than significant.***

The CIWMA requires cities and counties to reduce their solid waste stream by 50% by 2000 "through source reduction, recycling, and composting activities" (Section 41780). This requires cities and counties to divert a substantial portion of the waste stream that would otherwise go to landfills by a variety of means. From 1989 to 2004, the estimated annual statewide diversion rate increased steadily from 10% to 48%, and in August 2006, the CIWMB announced that the state had met the legislatively imposed 50% waste diversion rate. In 2005, California achieved a 52% waste diversion rate and increased the diversion rate to 54% in 2006 (CIWMB 2008). Exhibit 4.3-1 illustrates these trends. Assuming these trends continue into the future, California will continue to meet the 50% waste diversion requirement as required by the CIWMA.

Adoption of the proposed project would probably result in an increase in the use of PEX tubing, with a proportionate decrease in the use of copper tubing (Table 4.3-1). Scrap copper tubing has a high salvage value and is always diverted from the waste stream and recycled (Theilen, pers. comm., 2008). Because PEX tubing is a thermoset plastic, it is very difficult to recycle. Therefore, an increase in the use of PEX tubing would slightly increase the total amount of solid waste going to landfills, and slightly decrease the overall solid waste diversion rate.




Source: CIWMB 2008

**Estimated Statewide Waste Diversion** **Exhibit 4.3-1**

Although implementation of the proposed project would be expected to slightly increase the amount of solid waste going to statewide landfills, the maximum amount of solid waste generated annually by the proposed project is not substantial in relation to the total amount of landfilled solid waste. Because the State of California is currently meeting the CIWMA diversion rate goal, the statewide diversion rate trend is on an upward trajectory, and implementation of the proposed project would not indirectly violate or cause noncompliance with the CIWMA, this impact is considered **less than significant**.

### MITIGATION MEASURES

No mitigation measures are necessary because the impact is less than significant.

## 4.3.4 SIGNIFICANT AND UNAVOIDABLE IMPACTS

Because all impacts would be less than significant, no solid waste impacts would be significant and unavoidable.

# 4.4 WATER QUALITY

During the scoping period and in prior code adoption cycles, a number of comments were received regarding potential water quality issues related to the use of PEX and, conversely, maintaining the prohibition against the use of PEX. Comments fall into three main categories: permeability, leaching, and corrosion, each of which is addressed in this section of the draft environmental impact report (DEIR). In addition to these water quality concerns, concerns about the formation of biofilm and potential for increased risk of Legionnaire's disease have been raised in comments. Biofilm and Legionnaire's disease is addressed in this DEIR in Section 4.2, "Public Health and Hazards."

Many comments have been made regarding the potential for chemicals to permeate PEX tubing, meaning the potential for chemicals to enter the PEX tubing from surrounding soil, water, or air. Several comments have asserted that this DEIR should consider whether PEX tubing should be allowed to be installed under concrete slabs because of the potential for permeation to occur. This section considers the potential for chemicals to permeate PEX tubing and whether installation below the slab would increase this potential.

Concerns have been raised that PEX tubing has the potential to leach hazardous compounds, meaning that chemicals may come out of the tubing itself and enter drinking water. This section considers the potential for chemicals to leach from PEX tubing and whether any such leaching would result in significant environmental or human health impacts.

Finally, many comments have been made regarding the corrosion of copper piping and the threat posed by the trend toward use of chloramines in favor of chlorine for disinfection of drinking water supplies to increase the potential risks to impaired water bodies and human health from such corrosion. This DEIR evaluates this issue in the context of the No Project Alternative.

## 4.4.1 REGULATORY SETTING

Federal and State of California regulations related to the potential water quality impacts of using PEX pipes are described below. No local water quality plans, policies, regulations, or laws are applicable to the proposed project.

### FEDERAL PLANS, POLICIES, REGULATIONS, AND LAWS

#### Federal Safe Drinking Water Act

Pursuant to the federal Safe Drinking Water Act (42 United States Code Section 300f et seq.), the U.S. Environmental Protection Agency (EPA) establishes national standards for drinking water using a two-step process. First, it establishes what are known as public health goals (PHGs), which are science-based standards at which there is no risk to human health. Second, it considers available technology and cost of treatment to determine the National Primary Drinking Water Regulations that set enforceable regulatory standards called maximum contaminant levels (MCLs). The Safe Drinking Water Act has strict standards for bacteria in drinking water and meeting these standards generally requires disinfection. Pursuant to the Supremacy Clause in the U.S. Constitution (Article VI, Clause 2) states may not adopt regulations that are less stringent than the federal standard. The federal act provides a floor of regulatory standards; it also provides the states authority to adopt more stringent standards.

#### Lead and Copper Rule

The Lead and Copper Rule (LCR), Code of Federal Regulations 141.81, was established in 1991. The goal of the LCR is to provide maximum human health protection by reducing lead and copper at consumers' taps. To accomplish this goal, the LCR establishes requirements for community and nontransient/noncommunity water systems. These systems must conduct periodic monitoring and optimize corrosion control. In addition, these systems must perform public education when the level of lead at the tap exceeds the lead action level, treat source water if it is found to contribute significantly to high levels of lead or copper at the tap, and replace lead service lines in the distribution system if the level of lead at the tap continues to exceed the lead action level after optimal corrosion control has been installed. The action levels are 0.015 milligrams per liter (mg/L) for lead and 1.3 mg/L for copper, and the maximum contaminant level goals, which is similar in concept to a PHG, is 0 mg/L for lead and 1.3 mg/L for copper.

The LCR requires water suppliers to (1) optimize their treatment system to control corrosion in customers' plumbing, (2) determine tap water levels of lead and copper for customers who have lead service lines or lead-based solder in their plumbing system, (3) rule out the source water as a source of significant lead levels, and (4) if lead action levels are exceeded, educate their customers about lead and suggest actions they can take to reduce their exposure to lead through public notices and public education programs. If a water system, after installing and optimizing corrosion control treatment, continues to fail to meet the lead action level, it must begin replacing the lead service lines under its ownership. Lead service lines are uncommon in California where the primary sources of lead in drinking water are lead solder and leaching from brass plumbing fixtures.

### Disinfection By-Products Rules

EPA drinking water standards require the disinfection of drinking water to kill pathogenic microorganisms that can threaten human health. However, disinfectants, particularly chlorine, react with naturally occurring organic and inorganic matter present in water to form chemicals called disinfection by-products (dbps). EPA began promulgating rules to reduce exposures to dbps in 1979. That first rule applied only to community water systems serving at least 10,000 people and set the MCL at 0.10 mg/L for total trihalomethanes (TTHMs), a class of dbps of concern.

EPA has determined that a number of dbps pose a health concern. Certain dbps, including TTHMs and some of the total haloacetic acids (HAA5) have been shown to cause cancer in laboratory animals. Other dbps have been shown to affect the liver and the nervous system and cause reproductive or developmental effects in laboratory animals. There are also limited studies that indicate that certain dbps may produce similar effects in people.
In 1998, based on the above described studies, EPA finalized the Stage 1 rule, which applies to all community and nontransient noncommunity water systems that add a chemical disinfectant to the water. The rule established what are known as maximum residual disinfectant level goals and enforceable maximum residual disinfectant level standards for three chemical disinfectants: chlorine, chloramines, and chlorine dioxide. It also established maximum contaminant level goals for three trihalomethanes (THMs), two haloacetic acids (HAAs), and bromate and chlorite. It also lowered the MCLs for TTHMs and HAA5 to 0.080 mg/L and 0.06 mg/L, respectively. Under this rule, systems that use surface water, or groundwater under the direct influence of surface water, were required to remove increased percentages of organic materials that may react with disinfectants to create dbps.

In 2006, EPA adopted the Stage 2 rule, which focuses on identifying higher risk locations in distribution systems and on reducing exposures and lowering dbp peaks that have been associated with miscarriage in some smaller studies.

## STATE PLANS, POLICIES, REGULATIONS, AND LAWS

### California Safe Drinking Water and Toxic Enforcement Act

The California Health and Safety Code prohibits the discharge of chemicals that cause cancer or reproductive toxicity into drinking water (California Health and Safety Code Section 25249.5 et seq.). This code section was originally enacted as a part of the California Safe Drinking Water and Toxic Enforcement Act (popularly known as Proposition 65 or "Prop 65"). For purposes of Proposition 65, a "discharge" occurs if any detectable amount of the chemical is found. (*Mateel Environmental Justice Foundation v. Gray* [2003] 115 Cal.App.4th 8, 19.) Health and Safety Code Section 25249.9 provides an exemption to this prohibition, stating that the prohibition does not apply if (1) the discharge will not cause any significant amount of the discharged or released chemical to enter any source of drinking water and (2) the discharge is in conformity with all applicable laws, regulations, permits, requirements, and orders. The regulations implementing Proposition 65 (California Code of Regulations, Title 22, Division 2, Part 2, Chapter 3. Section 12711, subdivision [a]) state that, with certain exceptions, the levels of exposure deemed to pose no significant risk for drinking water are:

- drinking water MCLs adopted by the California Department of Public Health (DPH) for chemicals known to the state to cause cancer;

- drinking water action levels (also known as "notification levels") for chemicals known to the state to cause cancer for which MCLs have not been adopted;

- specific numeric levels of concentration for chemicals known to the state to cause cancer that are permitted to be discharged or released into sources of drinking water by a Regional Water Quality Control Board in a water quality control plan or in waste discharge requirements, when such levels are based on considerations of minimizing carcinogenic risks associated with such discharge or release.

Section 12805 establishes similar standards for chemicals that cause reproductive toxicity. Additionally, Section 12705 authorizes the Office of Environmental Health Hazard Assessment (OEHHA) to adopt "No Significant Risk Levels" for carcinogens and "Maximum Allowable Dose Levels" (MADLs) for reproductive toxicants that are intended to provide "safe harbors" for dischargers. MADLs represent the "No Observable Effect Level" (NOEL).

The act creates a cause of action that the State Attorney General may prosecute to assess civil penalties of up to $2,500 for each day of a violation and to enjoin the release of Proposition 65 chemicals. Enjoining is an equitable remedy imposed by courts as a means of making the injured party whole. In the case of a discharge into California drinking water, the court might require the discharge to be stopped and possibly for treatment or other affirmatives steps to be taken to remove the contamination and the source of the discharge. Courts have significant flexibility in crafting equitable remedies. The California courts have interpreted the act to prohibit discharge of Proposition 65 chemicals into drinking water from plumbing materials and fixtures through which drinking water passes (*People ex rel. Lungren v. Superior Court* [1986], 58 Cal.Rptr.2d 855). In that case, manufactures were required to pay millions of dollars in penalties to the state and to reformulate their fixtures to reduce the leaching of lead in compliance with the requirements of Proposition 65.

### California Safe Drinking Water Act

The California Safe Drinking Water Act (California Health and Safety Code Section 116270) was passed to ensure that water delivered by public water systems is "pure, wholesome and potable" (California Health and Safety Code Section 116270[e]). The act states that, "It is the policy of the state to reduce to the lowest level feasible all concentrations of toxic chemicals that when present in drinking water may cause cancer, birth defects, and other chronic diseases" (California Health and Safety Code Section 116270[d]). The act provides for the process of adopting drinking water standards and, as described below, the California Administrative Code at Title 22, Division 4, Chapter 15, provides the standards for contaminants.

The act also provides for the establishment of "notification levels" and "response levels" (also known as source removal) (California Health and Safety Code Section 116454 et seq.). "Notification level" means the concentration level of a contaminant in drinking water delivered for human consumption that DPH determined may pose a health risk and warrants notification. Notification levels are nonregulatory, health-based advisory levels established by DPH for contaminants in drinking water for which MCLs have not been established. Notification levels are established as precautionary measures for contaminants that may be considered candidates for establishment of MCLs, but have not yet undergone or completed the regulatory standard-setting process prescribed for the development of MCLs. Chemicals for which notification levels are established may eventually be regulated by MCLs (after a formal regulatory process), depending on the extent of contamination, the levels observed, and the risk to human health. Notification levels may be revised to reflect new risk assessment information. The notification levels are calculated using standard risk assessment methods for noncancer and cancer endpoints, including assuming a 2-liter per day ingestion rate, a 70-kilogram adult body weight, and a 70-year lifetime. For carcinogens, the notification level is considered to pose “de minimis” risk, or one cancer risk in a population of one million people. Notification levels are not drinking water standards but are generally supported by a health risk assessment prepared by OEHHA.

A “response level” is the concentration of a contaminant in drinking water delivered for human consumption at which DPH recommends that additional steps, beyond notification, be taken to reduce public exposure to the contaminant. (California Health and Safety Code Section 116455.) If a chemical concentration exceeds the response level DPH recommends that the drinking water system take the water source out of service (DPH 2007a). Chemicals that pose a cancer risk have a response level that is generally 100 times the notification level.

### Title 22 of the California Code of Regulations

Title 22 of the California Code of Regulations contains California standards for drinking water quality. Using a process similar to that used under the federal Safe Drinking Water Act, California sets its own PHGs and MCLs, which are at least as health protective as the federal standards. The California primary drinking water standard (i.e., the regulatory standard) is set through a two-step process: risk assessment, performed by OEHHA and expressed in a PHG and risk management assessment, performed by DPH expressed in an MCL.

In the risk assessment portion, OEHHA evaluates the risk to public health posed by the contaminant and, based on the results of the risk assessment, establishes a PHG. The PHG is the level at which the contaminant will not pose a significant risk of either acute (sudden and severe) or chronic (prolonged or repeated) effects to human health. In determining a PHG for a contaminant, OEHHA is allowed to consider only health-related data and not the economic costs of meeting the PHG. (California Health and Safety Code, Section 1163659[c]) A PHG is not an enforceable regulatory limit; rather, it is a goal and is also the health-related number that is used to determine the regulatory MCL.

DPH has the responsibility to assess risk management and is required to adopt an MCL as close as technically and economically feasible as possible to the PHG (Health and Safety Code Section 116365 [a]). DPH is required to consider the costs to public water systems, customers, and other affected parties to comply with the proposed standard including the cost per customer and the aggregate cost of compliance using the best available technology. The MCL, which is the enforceable regulatory limit, also known as the primary drinking water standard, is then included in the California Code of Regulations.

DPH also adopts what are known as secondary standards or secondary MCLs. Secondary MCLs address taste and odor concerns. Though secondary MCLs are not enforceable under federal law, they are enforceable in California at the request of an affected community.

### Odors

With respect to the proposed project, odor impacts would be in the form of perceived quality of water by the end user. PEX tubing is not completely impermeable; the molecular structure of the pipe material has very small openings, or pores, that could allow gases or liquids, depending on molecular size, to pass through in either direction. If compounds that affect taste and odor of water permeate from the soil into PEX tubing, it is possible that water quality as perceived by the user could be affected. Certain compounds with potential to leach from PEX tubing could also affect taste and odor and thus the perceived quality of drinking water. DPH sets primary standards designed to protect public health, but also secondary drinking water standards for taste and odor. For example, the taste and odor standard for methyl tertiary-butyl ether (MTBE) in drinking water, is 5 ug/L, or 5 parts per billion (ppb), below which odor or taste associated with this compound is imperceptible by most members of the public (DPH 2007b). The health-based standard for MTBE in drinking water is 13 ppb (DPH 2007b).

### Drinking Water Source and Assessment Program

The 1996 federal Safe Drinking Water Act amendments require each state to develop and implement a Source Water Assessment Program. Section 11672.60 of the California Health and Safety Code requires DPH to develop and implement a program to protect sources of drinking water, specifying that the program must include both a source water assessment program and a wellhead protection program. In response to both of these legal mandates, DPH developed the Drinking Water Source and Assessment Program (DWSAP).

California's DWSAP addresses both groundwater and surface water sources. The groundwater portion of the DWSAP serves as the state's wellhead protection program. In developing the surface water components of the DWSAP, DPH integrated the existing requirements for watershed sanitary surveys.

Specifically for groundwater, the DWSAP includes requirements that specify the minimum distance, or the minimum "travel" time, between known contaminant plumes and municipal groundwater extraction well sites. The intent is to place municipal production wells a sufficient distance from known contaminant plumes to reduce or eliminate the possibility of extracting contaminated groundwater. Under DWSAP, all new and existing drinking water sources must undergo a drinking water source assessment before being permitted. The general elements of the assessment include delineation of an area around a drinking water source through which contaminants might move and reach the source, an inventory of possible contaminating activities that might lead to the release of microbiological or chemical contaminants within the delineated area, and a determination of the possible contaminating activities to which the drinking water source is most vulnerable (DPH 2000).

## 4.4.2 EXISTING SETTING

This section contains a brief overview of the current use of piping materials and the effects those materials may have on the environment at the present time. As is described below, every type of piping currently available for use raises certain environmental and public health concerns. Based on this setting, which is the baseline for purposes of environmental impact analysis, this DEIR assesses whether the projected increase in the use of PEX that would likely result from approval of the proposed project would result in a potentially significant and adverse impact on the environment or on human health.

Current market share of PEX and other plumbing materials in California establish the context for the existing environmental setting related to water quality and the baseline against which potential water quality impacts of the proposed project will be compared. As explained in Section 3.4.4, "Current and Projected Uses of PEX," as of 2005 the market share for various plumbing materials in new homes in California was approximately 29% PEX, 13% chlorinated polyvinyl chloride (CPVC), 54% copper, and 4% for all other materials (HCD 2006; Ash, pers. comm., 2008). Though more-current market share data for copper and CPVC is not available, the most current data for PEX (2006) indicates that its share of the market for plumbing materials in new single family homes in California has grown to approximately 37% (Ash, pers. comm., 2008). No data is available on market share for commercial and industrial uses.

### PEX

PEX was first developed in Europe and has since come into use around the world for a variety of applications. PEX has a 30-year history of use in the European market. It was first introduced in North America in 1984 where it has been primarily used for radiant floor heating, and more recently, for domestic water distribution systems. It is approved for potable hot and cold water supply systems as well as hydronic heating systems in all model plumbing and mechanical codes across the United States (NAHB Research Center 2006:1). PPFA estimates that 132 million feet of PEX were shipped to California in 2005 (PPFA 2007). According to PPFA (Church, pers. comm., 2007), PEX has been used in potable water applications in local jurisdictions in California including the Highland area, Santa Clarita, Redding, Chula Vista, and Village of Lakes since the early to mid-1990s.

PEX is currently used in California for radiant heating systems, manufactured homes, certain approved institutional uses, and for hot and cold water distribution, including potable water uses in approximately 230 local jurisdictions, as discussed in Section 3.4.4, "Current and Projected Uses of PEX." Those local jurisdictions make up more than 40% of California cities and more than 50% of California counties. These uses currently account for approximately 37% of the market for plumbing materials in new single-family homes in California. Some concerns with PEX include its potential to leach some of the chemicals from which it is made into the water passing through it and to be permeated by organic compounds, particularly solvents that may be present in contaminated soils or groundwater.

### COPPER

According to the Copper Development Association, Copper has been in use in plumbing for over 2000 years (it has been found in serviceable condition in the ruins of ancient Egypt), though its widespread use in the United States began in the 1920s (Copper Development Association 2008). As recently as 10 years ago, copper accounted for 90% of all plumbing materials in existing homes throughout the United States. In 2004, copper made up 62% of the market for plumbing materials in new homes in California. It likely accounts for a significantly greater percentage in existing homes, though no current data are available for piping in existing homes. Copper is an essential nutrient, but is also toxic at elevated doses, which can harm the environment and human health (Risk Assessment Information System 2005). When it is newly installed before flushing, and again over time, copper corrodes and is released into water that passes through it. The concentration of copper released into the water is highly dependant on the corrosivity of the water flowing through the pipe, the duration of standing water in the pipe, and the age of the pipe (FDA 2003:109). With the trend toward use of chloramines for disinfection and reverse osmosis for treatment, water in many parts of the state is becoming increasingly corrosive. This has resulted in some water agencies failing to meet the requirements of the copper and lead rule and some wastewater agencies exceeding the total maximum daily load (TMDL) for copper in various water bodies throughout the state. A TMDL is a threshold that in California is established by the regional water quality control boards. Specifically, a TMDL is a calculation of the maximum amount of a pollutant that a water body can receive without impairing the beneficial uses of that particular water body (e.g., drinking water, agricultural uses, swimming) and an allocation of that amount to the pollutant's sources. The issue of corrosion and potential impacts on water quality is discussed in greater depth in Impact 4.4-3 below.

### CPVC

For over 20 years California has approved the use of CPVC for street water mains and polyvinyl chloride (PVC) for the service line from the street water main to the house. From 2001 until January 1, 2008, the California Plumbing Code allowed the use of CPVC for residential potable water distribution if specific findings were made and worker safety and flushing requirements were met. (HCD 2006:106.) Since January 1, 2008, the California Plumbing Code has allowed the statewide use of CPVC for hot and cold water distribution, including potable water uses. Concerns with CPVC include emissions of reactive organic gases and ozone precursors, from the solvents used for installation of CPVC, in volumes that exceed local air district thresholds for reactive organic gases and in areas that are in nonattainment for federal and state ozone regulations.

### ODORS

Odors are generally regarded as an annoyance rather than a health hazard. However, manifestations of a person's reaction to foul odors can range from psychological (e.g., irritation, anger, anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, headache).

With respect to odors, the human nose is the sole sensing device. The ability to detect odors varies considerably among the population and is quite subjective. Some individuals have the ability to smell very minute quantities of specific substances; others may not have the same sensitivity but may have sensitivities to odors of other substances. In addition, people may have different reactions to the same odor; in fact, an odor that is offensive to one person (e.g., from a fast food restaurant) may be perfectly acceptable to another. Unfamiliar odors are more easily detected than familiar odors and are more likely to cause complaints. This is because of the phenomenon known as odor fatigue, in which a person can become desensitized to almost any odor and recognition occurs only with an alteration in the intensity.

Quality and intensity are two properties present in any odor. The quality of an odor indicates the nature of the smell experience. For instance, if a person describes an odor as flowery or sweet, then the person is describing the quality of the odor. Intensity refers to the strength of the odor. For example, a person may use the word “strong” to describe the intensity of an odor. Odor intensity depends on the odorant concentration in the air. When an odorous sample is progressively diluted, the odorant concentration decreases. As this occurs, the intensity of the odor weakens and eventually becomes so low that detection or recognition of the odor is quite difficult. At some point during dilution, the concentration of the odorant reaches a detection threshold. An odorant concentration below the detection threshold means that the concentration in the air is not detectable by the average human.

A water utility needs to provide drinking water free of objectionable tastes and odors, because users often judge water quality by its aesthetic properties. Leaching of system materials (such as those used in water distribution systems; here, PEX tubing) or the permeation of compounds from outside the system (e.g., from soil, water, or vapors) can affect the taste and odor of water.

## 4.4.3 ENVIRONMENTAL IMPACTS

### ANALYSIS METHODOLOGY

This analysis relies, in part, on testing conducted by NSF International, Inc. (NSF). NSF, founded in 1944 as the National Sanitation Foundation, is a not-for-profit testing organization that has developed product standards and provided third-party conformity assessment services to government, users, and manufactures/providers of products and systems (McLellan, pers. comm., 2008). NSF has been developing standards for testing and certification of plastics since 1965. NSF is also one of only a handful of organizations certified by ANSI (American National Standards Institute) to perform testing and certification to ANSI/NSF Standard 61 (which is discussed below). Others include International Association of Plumbing & Mechanical Officials, Underwriters Laboratories Inc., and the Water Quality Association.

ANSI has served for nearly 90 years as administrator and coordinator of standardization programs in the United States (www.ansi.org). This private, nonprofit organization is comprised of more than 1,000 government agencies, professional societies, and corporations. ANSI facilitates the development of American National Standards by accrediting the procedures of organizations that develop standards. Accreditation by ANSI signifies that the procedures used by the standards body meet the ANSI’s requirements for openness, balance, consensus, and due process. ANSI oversees hundreds of organizations that develop standards and over 10,000 American National Standards.

The analysis of environmental effects is based on review and application of the applicable laws and regulations identified in the regulatory setting above; the NSF/ANSI Standard 61—Drinking Water System Components and the NSF/ANSI Standard 14—Plastic Piping System Components and Related Materials Standard Testing Methods; PEX testing data received from NSF; and review of studies addressing potential permeability and leachability. This analysis relied on information contained in the following documents:

- Brocca, D., E. Arvin, and H. Mosbaek. 2002. Identification of organic compounds migrating from polyethylene pipelines into drinking water. *Water Research*, 36: 3675–3680.

- Chemaxx. 2005. Cross-linked polyethylene tubing and water contamination. Available: <http://www.chemaxx.com/polytube1.htm>. Last updated March 11, 2005.

- Durand, M. L., and A. M. Dietrich. 2007. Contributions of silane cross-linked PEX pipe to chemical/solvent odours in drinking water. *Water Science and Technology* 55(5): 153–160.
- Hoffmann, M. R. 2005. *Analysis of PEX and drinking water supplies relative to the UPC of California*. Report provided to the California Building Standards Commission.
- Lee, R. G. 1985 (November 5). *Investigation of plastic pipe permeation by organic chemicals*. Kentucky-Tennessee American Water Works Association Section Meeting.
- NSF International. 2000 (April). *NSF testing of Wirsbo Aqua PEX ½ inch*. Laboratory Report. Ann Arbor, MI.
- NSF International. 2005. *Frequently Asked Questions on Health Effects of PEX Tubing*. Ann Arbor, MI.
- NSF International. 2007. *Drinking Water System Components Health Effects*. NSF/ANSI Standard 61. Ann Arbor, MI.
- McLellan, Clifton. Director of toxicology services. NSF International, Ann Arbor, MI. March 12, 2008—Letter from Clifton McLellan regarding extraction levels exceeding California drinking water standards. Ann Arbor, MI.
- Skjevrak, I., A. Due, K. O. Gjerstad, and H. Herikstad. 2003. Volatile organic components migrating from plastic pipes (HDPE, PEX and PVC) into drinking water. *Water Research* 37: 1912–1920.
- Tomboulian, P., L. Schweitzer, K. Mullin, J. Wilson, and D. Khiari. 2004. Materials used in drinking water distribution systems: contribution to taste and odor. *Water Science and Technology*, 45(9): 219–226.

These documents are available for review at the California Department of General Services, Real Estate Services Division, Professional Services Branch, Environmental Services Division, 707 Third Street, Suite 3-400, West Sacramento, CA 95605.

## THRESHOLDS OF SIGNIFICANCE

The thresholds for determining the significance of impacts for this analysis are based on the environmental checklist in Appendix G of the California Environmental Quality Act Guidelines. The proposed project would result in a significant effect related to water quality if it would:

- violate any water quality standards such that implementation of the proposed project would result in a level of a contaminant in drinking water that exceeds a federal or state MCL, notification or response level, or a Proposition 65 Safe Harbor or other relevant Proposition 65 level; or
- violate any water quality standards such that implementation of the proposed project would result in a level of a contaminant in drinking water that exceeds a federal or state secondary MCL for taste and odor.

## IMPACT ANALYSIS

IMPACT 4.4-1

**Water Quality—Noncompliance with Drinking Water Standards Resulting from Leaching.** *The project would increase the use of PEX tubing in California. Because testing indicates that a proportion of PEX tubing has been associated with leaching levels of MTBE and tertiary butyl alcohol (TBA) at levels exceeding the California primary and secondary MCLs for MTBE and exceeding the California notification and response levels for TBA, and because PEX has the potential to leach Proposition 65 chemicals in concentrations higher than allowed under the Proposition 65 statute and its implementing regulations, this impact is* **potentially significant**.

PEX tubing is tested by NSF International to determine whether compounds leaching from the piping are found at concentrations greater or less than the NSF reference criteria (which are derived from EPA and Health Canada drinking water standards and NSF-derived risk-based levels). Leaching means that chemicals are introduced into the drinking water from the PEX itself, which is a very different concept from permeation, where chemicals may be introduced into the drinking water from the chemicals in contaminated soils or groundwater water that surrounds and enters the drinking water through the tubing. For some compounds, California has adopted PHGs, or PHGs and MCLs, notification levels, response levels, Proposition 65 Safe Harbor levels, and secondary MCLs based on taste and odor considerations (which are not considered in the NSF protocol), that are more stringent than the standards used by NSF. Therefore, it is possible that some compounds could leach from PEX in concentrations that exceed California drinking water criteria, even though they may comply with EPA criteria or other criteria used by NSF.

### NSF/ANSI Standard 61 Testing Protocol

NSF International has tested PEX piping from various manufacturers and certified the piping to NSF/ANSI Standard 61, Drinking Water System Components—Health Effects. This standard establishes requirements for the testing and evaluation of contaminants that are extracted from water that has been exposed to the material or products that convey potable water (McLellan, pers. comm., 2007). There are 271 PEX products produced at 47 manufacturing sites currently certified by NSF International to the health effects requirements of NSF/ANSI Standard 61 (Id.). PEX piping is tested by exposing the piping to formulated exposure waters of differing pH, and then analyzing the exposure waters for contaminants. Three separate formulated waters are used during the product exposure. Exposure waters of pH 5.0 and pH 10.0 are used because these waters aggressively extract metallic contaminant. An exposure water of pH 8.0 is used for extracting organic contaminants. The piping is tested with water heated to 140$^{o}$F (30$^{o}$C) for domestic hot water systems and to 180$^{o}$F (82$^{o}$C) for commercial hot water systems (NSF International 2005). Upon completion of exposure, the water is analyzed for a predetermined suite of compounds, including:

- volatile organic compounds;
- semi-volatile organic compounds;
- phenolics;
- regulated metals including antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium and thallium;
- methanol;
- TBA;
- MTBE; and
- any other potential contaminants identified during the formulation review.

### NSF International Drinking Water Criteria

NSF compares any detected compounds against the NSF drinking water criteria. These criteria are described in NSF/ANSI Standard 61, Drinking Water System Components Health Effects (NSF International 2007). The testing criteria established for NSF/ANSI 61 are contained in Annex D of NSF/ANSI 61. The criteria are established using:

- consensus EPA and Health Canada drinking water criteria,

- criteria for nonregulated contaminants that have been developed according to the toxicity data requirements of Annex A [of NSF/ANSI Standard 61] and that have been externally peer reviewed, and

- nonregulatory EPA guidance values that have been reviewed and found to satisfy Annex A toxicity data requirements.

Annex E of NSF/ANSI Standard 61 contains “informational” drinking water criteria, which have not undergone external peer review. The drinking water criteria in this annex are intended to be used as guidance in the determination of evaluation criteria for those compounds that do not have normative evaluation criteria established. NSF/ANSI Standard 61 states that its drinking water criteria do not include taste and odor considerations.

### Testing Over Time

PEX manufacturers have suggested that levels of MBTE and TBA that leach from PEX decline over time. Testing by NSF has been initiated to determine if, and at what rate, the levels decline, and to determine if it is a reasonable assumption that levels would decline to concentrations at or below California criteria within a limited period of time. NSF Standard 61, Section 4.5.4.3, is the multiple time point protocol for over-time testing. The protocol states that the testing will be conducted over 90 days. The protocol also states that extrapolation may be used by plotting the relationship between contaminant concentration and time using a minimum of five data points. PPFA provided further details on the protocol being followed, stating that the testing will result in 8 data points in the first 17 days of testing to establish an initial rate of reduction in contaminant levels (also known as decay). Data points will be taken every 2 weeks thereafter for at least 90 days to establish longer-term rates of decay (Taber, pers comm., 2008). Initial testing results as of day 21 indicate a general trend of decay of MTBE and TBA over time (see Appendix F).

### Comparison of NSF Criteria and California Drinking Water Standards

For some compounds, California has developed drinking water criteria that are more stringent than those used by NSF. Therefore, it is possible that some compounds could be present in water from NSF-approved pipe that would exceed California drinking water criteria. A list of compounds that may leach from PEX piping was compiled based on various reports (Table 4.4-1). The first set of compounds in Table 4.4-1 (compounds in polyethylene (PE), high-density polyethylene [HDPE], and PEX) are from Tomboulian et al. (2004) who compiled a list of compounds found by NSF to leach from various water distribution system components. Some of these compounds may be present in PE or HDPE piping, and not in PEX tubing, but the article does not differentiate between these materials. Tomboulian et al. (2004) also list compounds that have leached from polyurethane coatings and liners. These compounds are considered relevant because polyurethane coatings and liners are often used with PEX tubing. In addition to the compounds listed in this paper, additional potentially leachable compounds were compiled from other sources, including Skjevrak et al. (2003). Table 4.4-1 also lists the hierarchy of NSF drinking water criteria for these compounds and California drinking water standards and Proposition 65 listings, if available. Many of the listed compounds do not have NSF criteria or California standards. As discussed above under Section 4.4.1, “Regulatory Setting,” California drinking water standards include PHGs, MCLs, and secondary MCLs (which are usually based on aesthetic considerations), notification levels, response levels (also known as source removal), and Proposition 65 Safe Harbor levels.

There is some terminology that is used by NSF that helps one to better understand the testing methods and interpret the data, but which is unfamiliar to many people. The following explanations may be helpful. A total allowable concentration (which this DEIR refers to as “aqua TAC” to avoid confusion with term TAC as it is used in Air Quality) is the maximum concentration of a nonregulated contaminant allowed in a public drinking water supply, and the single product allowable concentration (SPAC) is 10% of the aqua TAC. A SPAC is the maximum concentration of a contaminant in drinking water that a single product is allowed to contribute. An aqua TAC is the maximum concentration of a nonregulated contaminant allowed in a public drinking water supply.

## Table 4.4-1
## Chemicals Potentially Present in PEX Tubing and Comparison between NSF Criteria and California Drinking Water Standards (in Mg/L)

| Chemical | NSF Values (Standard 61)[1] | | | | | | | | | | | California Standards | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D1 | | D2 | | | D3 | | D4 | E1 | | E2 | | | | | | |
| | USEPA/ Health Canada MCL/MAC | USEPA/ Health Canada SPAC | NSF Peer-Reviewed Aqua TAC | NSF Peer-Reviewed SPAC | NSF Peer-Reviewed STEL | NSF based on USEPA guidance Aqua TAC | NSF based on USEPA guidance SPAC | TOE[7] | NSF International Aqua TAC | NSF International SPAC | TOE[7] | Listed in Prop. 65?[2] | Prop 65 Safe Harbor | PHG[3] | MCL[4] | Secondary MCL [4] | Notification/ Response Levels[5] |
| | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | | mg/L | mg/L | mg/L | mg/L | mg/L |
| **Chemicals in Polyethylene, HDPE or PEX[8]** | | | | | | | | | | | | | | | | | |
| acetophenone | | | 0.2 | 0.02 | 1 | | | | | | | | | | | | |
| 2,4-bis(dimethylethyl)phenol | | | | | | | | | | | | | | | | | |
| Benzene | 0.005 | 0.0005 | | | | | | | | | | x | .0064 | 0.00015 | 0.001 | | |
| benzothiazole | | | | | | | | x | | | | | | | | | |
| bis-(dimethylethyl)benzene | | | | | | | | | | | | | | | | | |
| bisphenol A | | | | | | | | | 0.1 | 0.01 | | | | | | | |
| BHT (methyl di(t-butyl)phenol) | | | | | | | | | | | | | | | | | |
| carbon disulfide | 0.7 | 0.07 | | | | | | | | | | x | | | | | .16 / 1.6 |
| cyclohexadienedione | | | | | | | | | | | | | | | | | |
| cyclo-hexanone | | | 30 | 3 | 40 | | | | | | | | | | | | |
| cyclopentanone | | | | | | | | x | | | | | | | | | |
| diazadiketo-cyclotetradecane | | | | | | | | | | | | | | | | | |
| dicyclopentylone | | | | | | | | | | | | | | | | | |
| dimethylhexanediol | | | | | | | | x | | | | | | | | | |
| di-t-butyl oxaspirodecadienedione | | | | | | | | | | | | | | | | | |
| hydroxymethylethylphenyl ethanone | | | | | | | | | | | | | | | | | |
| isobutylene | | | | | | | | x | | | | | | | | | |
| methanol | | | 20 | 2 | 20 | | | | | | | | | | | | |
| methyl butenal | | | | | | | | x | | | | | | | | | |
| methyl di-t-butyl hydroxyphenyl proprionate | | | 0.02 | 0.002 | 0.1 | | | | | | | | | | | | |
| methyl (di-t-butylhydroxy-phenyl) propionate | | | | | | | | | | | | | | | | | |
| methylbutenol | | | | | | | | | | | | | | | | | |
| nonylcyclopropane | | | | | | | | | | | | | | | | | |
| phenolics | | | | | | | | | | | | | | | | | |
| phenylenebis-ethanone | | | | | | | | | | | | | | | | | |
| propenyl-oxymethyl oxirane | | | | | | | | | | | | | | | | | |
| tertiary butyl alcohol | | | 9 | 0.9 | 40 | | | | | | | | | | | | 0.012/ 1.2 |
| tetrahydrofuran | | | | | | | | | 1 | 0.37 | | | | | | | |
| trichloroethylene | 0.005 | 0.0005 | | | | | | | | | | x | | 0.0008 | 0.005 | | |
| **Polyurethane coatings and liners (h):** | | | | | | | | | | | | | | | | | |
| 1,4-butanediol | | | | | | | | | | | | | | | | | |
| 4,4-methylenedianiline | | | | | | | | | 0.001 | 0.0001 | | x | .0004 | | | | |
| bis(2-ethylhexyl)phthalate | | 0.0006 | 0.0006 | | | | | | | | | x | | 0.012 | 0.004 | | |
| bisphenol A diglycidyl ether | | | 1 | 0.1 | 5 | | | | | | | | | | | | |
| butyl benzyl phthalate | | | | | | 1 | 0.1 | | | | | x | | | | | |
| diphenyl(ethyl)phosphine oxide | | | | | | | | | | | | | | | | | |
| di-t-butyl methoxyphenol | | | | | | | | | | | | | | | | | |
| ethylhexanol | | | | | | | | | 0.05 | 0.05 | | | | | | | |
| tetramethyl peperidinone | | | | | | | | | | | x | | | | | | |
| toluene diamine | | | | | | | | | | | | x | | | | | |
| **Additional Chemicals[9]:** | | | | | | | | | | | | | | | | | |
| methyl tert butyl ether (MTBE) | | | | | | 0.05[6] | | | | | | | | 0.013 | 0.013 | 0.005 | |
| phthalates | | | | | | | | | | | | | | | | | |
| carbon black | | | | | | | | | | | | x | | | | | |
| benzo(a)pyrene | 0.0002 | 0.00002 | | | | | | | | | | x | .00006 | 0.000004 | 0.002 | | |
| mercury | 0.002 | 0.0002 | | | | | | | | | | x | | 0.0012 | 0.002 | | |
| cadmium | 0.005 | 0.0005 | | | | | | | | | | x | .0041 | 0.00004 | 0.005 | | |
| PAHs | | | | | | | | | | | | | | | | | |
| **Additional Chemicals[10]:** | | | | | | | | | | | | | | | | | |
| 4-butoxyphenol | | | | | | | | | | | | | | | | | |
| 5-methyl-2-hexanone (MIAK) | | | 0.06 | 0.006 | 0.8 | | | | | | | | | | | | |
| **Additional Chemicals [11]:** | | | | | | | | | | | | | | | | | |
| chloroform | 0.08 | 0.008 | | | | | | | | | | x | .02 | | | | |
| toluene | 1 | 0.1 | | | | | | | | | | x | 7 | 0.15 | 0.15 | | |

Notes: Shaded chemicals represent those for which NSF values are higher than California drinking water values.
ANS = American National Standard; aqua TAC = total allowable concentration; MAC = maximum acceptable concentration; MCL = maximum contaminant level; mg/L = milligrams per liter; NSF = NSF International, Inc.; PEX = cross-linked polyethylene; PHG = public health goal; SPAC = single product allowable concentration; STEL = short-term exposure level; TOE = threshold of evaluation.
[1] NSF and ANSI, 2007: Drinking water systems components Health effects. NSF/ANSI 61 - 2007.
[2] OEHHA, 2007: Chemicals Known to the State to Cause Cancer or Reproductive Toxicity. Safe Drinking Water and Toxic Enforcement Act of 1986. [http://oehha.ca.gov/prop65/prop65_list/Newlist.html]
[3] OEHHA, 2008: Public Health Goals for Water. [http://oehha.ca.gov/water/phg/allphgs.html]
[4] CDPH, 2008: Table 64444-A, Table 64431-A and Table 64449-A. Title 22 California Code of Regulations California Safe Drinking Water Act & Related Laws and Regulations. [http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Lawbook.aspx].
[5] OEHHA, 1999: Water Notification Levels. [http://www.oehha.ca.gov/water/pals/index.html].
[6] This NSF value was not found in NSF (2007a), but has been referenced by other sources.
[7] Chemicals that did not meet the minimum data requirements to develop chemical specific concentrations were evaluated under the threshold of evaluation (TOE). As defined by Section A.7.1 of NSF Standard 61 (NSF International 2007), a risk assessment is not required for a substance if the normalized concentration is less than or equal to the following concentrations: 3 µg/L (micrograms per liter) (chronic exposure, static normalization conditions), 0.3 µg/L (chronic exposure, flowing normalized conditions), and 10 µg/L (short-term exposure, initial laboratory concentration).
[8] List of chemicals found by NSF to leach from system components (Tomboulian et al., 2004). Many of these chemicals may not be found in PEX.
[9] Various sources.
[10] Testing on PEX pipes conducted by Skjevrak et al. (2003).
[11] Detected chemicals during NSF testing of Wirsbo Aqua PEX testing, April 2000. Only those with at least one available NSF value or California standard are listed.
Source: Provided by ENSR in 2008.

NSF creates action levels (aqua TAC, SPACs, and short-term exposure levels [STELs]) for contaminants detected in laboratory testing of products in contact with drinking water and food, including potable water pipes and tubing. The basis for the action levels is the oral reference dose for noncancer risk assessment and the appropriate risk level for carcinogen risk assessment. EPA noncancer and cancer risk assessment procedures are followed and a risk assessment document is prepared.

Chemicals that are shaded in Table 4.4-1 are those for which the California primary or secondary MCL, the notification, response, or the Proposition 65 Safe Harbor levels are lower than the criteria used by NSF. The NSF testing results of PEX developed by specific manufacturers were not available, because individual pipe formulas and their test results are considered proprietary information. However, extraction levels for chemicals that may leach from PEX, for which the California primary or secondary MCL or the notification levels are more stringent than the NSF standards, without reference to specific types or manufacturers of PEX were able to be obtained from NSF (McLellan, pers. comm., 2008). These chemicals include benzene, cadmium, carbon disulfide, 1,1-dichloroethane, ethyl benzene, di(2-ethylhexyl) phthalate, MTBE, TBA, benzo(a)pyrene, and toluene. For all of the 271 PEX products that have been tested by NSF, the only chemicals found to exceed California MCLs or notification levels in some proportion of pipes tested were MTBE and TBA. Tables 4.4-2 and 4.4-3 depict NSF's actual extraction levels for MTBE and TBA.

There are certain Proposition 65 chemicals used in some PEX formulations for which NSF tests, but for which data were not available at the time of DEIR publication. These data have been requested, and protective mitigation recommended in the event extraction levels are shown to exceed California primary or secondary MCLs, or the notification, response, or the Proposition 65 Safe Harbor levels.

In addition, there are three Proposition 65 compounds (butyl benzyl phthalate, toluene diamine, and carbon black) used in some PEX formulations for which no California or federal drinking water criteria exist. NSF currently tests for one, butyl benzyl phthalate, and has adopted a total allowable concentration (or aqua TAC, detailed below) of 1 mg/L. NSF will need to conduct additional testing to certify that PEX meets Proposition 65 requirements for all listed compounds (see Mitigation Measure 4.4-1, below).

**Table 4.4-2**
**Extraction Levels for TBA As a Percentage of All Products Tested between January 1, 2005 and December 31, 2007.**

| Compound | Not Detected at 200 micrograms per liter (ug/L) | >200 to 1000 ug/L | >1000-9000 ug/L | < 9000 ug/L Resulting in Product Failure |
|---|---|---|---|---|
| tertiary butyl alcohol (TBA) | 62.1% | 19.4% | 10.9% | 7.6% |

Source: NSF International 2008.

**Table 4.4-3**
**Extraction Levels for MTBE As a Percentage of All Products Tested between January 1, 2005 and December 31, 2007.**

| Compound | Not Detected at 5 micrograms per liter (ug/L) | >5 to 13 ug/L | >13-20 ug/L | < 20 ug/L |
|---|---|---|---|---|
| methyl tertiary-butyl ether (MTBE) | 74.6% | 21.4% | 4% | 0% |

Source: NSF International 2008.

### Summary of Studies Regarding Leaching of Chemicals from PEX

In addition to the actual testing data that is available from NSF, there have been leaching tests conducted on PEX by a number of scientists. According to some of these tests, the type of PEX tubing known as PEX-A in some cases has been reported to exhibit MTBE and TBA at levels that are higher than the California EPA drinking water criteria for those chemicals. (Brocca, Arvin, and Mosbaek 2002; Chemaxx 2005) These data suggest that in some cases PEX-A would not meet current California criteria for MTBE and TBA in potable water systems. Generally the other two types of PEX, PEX-B and PEX-C, are cross-linked by different methods, and are not expected to release MTBE or TBA. (Chaduri, pers. comm., 2008.) However, peroxide is sometimes used with PEX-B as well as PEX-A and this is what is thought to contribute to MTBE leaching from PEX.

A study with PEX-B found concentrations of the oxygenate compound, 2-ethoxy-2-methylpropane, commonly called ETBE (ethyl-t-butyl ether). Aqueous concentrations of ETBE in pipe leachate ranged from 23 micrograms per liter (µg/L) to greater than 100 µg/L. People were able to smell ETBE at a concentration of 5 µg/L, therefore ETBE contributed to odor. ETBE does not have a drinking water criterion; however, MTBE, which is a structurally similar oxygenate, has a secondary MCL of 5 µg/L in California. This study reports that PEX-B could have concentrations of ETBE that could contribute to the taste and odor of drinking water.

PEX tubing, similar to other plastic products, has been found to leach various chemicals, including degradation products of antioxidants (which are added to the PEX during the manufacturing process to resist chlorine degradation). Drinking water standards have not been established for most of these antioxidant chemicals and many of them are unregulated; therefore, it would require speculation to reach a conclusion regarding the significance of any potential leaching of chemicals lacking drinking water standards into drinking water. According to Hoffmann (2005; which is a nonpeer reviewed analysis report submitted to the California Building Commission) these chemical concentrations are below those likely to cause adverse health effects. This DEIR evaluates and draws conclusions regarding the significance of the potential leaching of any chemical that is regulated by the federal government or the State of California.

### Testing Results of PEX Tubing from One Manufacturer

The NSF testing results of Wirsbo's one-half-inch Aqua PEX tubing (NSF International 2000) were made available and evaluated for comparison against California EPA drinking water criteria. The testing results showed that a number of compounds were detected in the test water (2,2-dichloropropane, chloroform, MTBE, toluene, and TBA). The compounds, their detected concentrations, and the NSF and California criteria are shown in Table 4.4-4. As shown in Table 4.4-4, the detected concentration of MTBE (17 µg/L) is less than the NSF criterion of 50 µg/L, but higher than the California MCL of 13 µg/L and secondary MCL of 5 µg/L. The detected concentration of TBA (6,900 µg/L) is less than the NSF criterion of 9,000 µg/L, but higher than the California EPA Notification Level of 12 µg/L and, in some cases higher than the California response level of 1,200 µg/L. The "response level" is the level at which DPH recommends removing a source from service. The other detected compound concentrations are lower than the NSF or California criteria (no criteria were available for 2,2-dichloropropane). These testing results show that some types of PEX tubing could leach compounds at concentrations higher than California criteria, even though these concentrations may be lower than EPA or other NSF criteria.

### Conclusion

Adoption of this regulation would likely increase the use of PEX for potable water uses in California. The leaching of TBA and MTBE at levels that exceed the California notification level and primary and secondary MCLs for these chemicals is associated with PEX-A and certain PEX-B formulations that use t-butyl peroxide for cross-linking polyethylene piping, as discussed in Chapter 3, "Description of the Proposed Project." These chemicals have been determined by the State of California to be potential human carcinogens. In addition, there are Proposition 65 chemicals that may or may not leach from PEX, three of which (butyl benzyl phthalate, toluene diamine, and carbon black) have no California or federal drinking water criteria and do not have Proposition 65 Safe Harbor levels. Because PEX has been associated with the leaching of MTBE at levels that, at least initially,

**Table 4.4-4**
**Results of NSF Testing of Wirsbo Aqua PEX (PEX-A) Testing and Comparison against Health-Based Criteria[1]**

| Chemical[2] | CAS | Detected Concentration | NSF Values (Standard 61)[3] | | | | | | California Values | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Detected Concentration | EPA/Health Canada MCL/MAC | EPA/Health Canada SPAC | NSF Peer-Reviewed Aqua TAC | NSF Peer-Reviewed SPAC | NSF Peer-Reviewed STEL | NSF based on USEPA guidance TAC | Listed in Prop. 65?[4] | PHG[5] | MCL[6] | Secondary MCL[6] | Notification/ Response Level[7] |
| | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | | mg/L | mg/L | mg/L | mg/L |
| 2,2-dichloropropane | 594-20-7 | 0.0017 | NA | NA | NA | NA | NA | NA | | NA | NA | NA | NA |
| chloroform | 67-66-3 | 0.0062 | 0.08 | 0.008 | NA | NA | NA | NA | x | NA | NA | NA | NA |
| MTBE | 1634-04-4 | 0.017 | 0.05[8] | | | | | | | 0.013 | 0.013 | 0.005 | NA |
| toluene | 108-88-3 | 0.0012 | 1 | 0.1 | NA | NA | NA | NA | x | 0.15 | 0.15 | NA | NA |
| 2-methyl-2-propanol (tertiary butyl alcohol/ TBA) | 75-65-0 | 6.9 | NA | NA | 9 | 0.9 | 40 | NA | | NA | NA | NA | 0.012 / 1.2 |

Notes:

ANS = American National Standard; aqua TAC = total allowable concentration; EPA = U.S. Environmental Protection Agency; MCL = maximum contaminant level; MAC = maximum acceptable concentration; mg/L = milligrams per liter; NA = not available; NSF = NSF International, Inc.; PEX = cross-linked polyethylene; SPAC = single product allowable concentration; PHG = public health goal; STEL = short-term exposure level.

[1] Testing conducted in April, 2000.

[2] Detected chemicals.

[3] NSF and ANSI 2007: Drinking water systems components Health effects. NSF/ANSI 61—2007.

[4] OEHHA 2007: Chemicals Known to the State to Cause Cancer or Reproductive Toxicity. Safe Drinking Water and Toxic Enforcement Act of 1986. [http://oehha.ca.gov/prop65/prop65_list/Newlist.html]

[5] OEHHA 2008: Public Health Goals for Water. [http://oehha.ca.gov/water/phg/allphgs.html]

[6] DPH 2008: Table 64444-A and Table 64431-A. Title 22 California Code of Regulations California Safe Drinking Water Act & Related Laws and Regulations. http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Lawbook.aspx

[7] OEHHA 1999: Water Notification Levels. [http://www.oehha.ca.gov/water/pals/index.html].

[8] This NSF value was not found in NSF (2007), but has been referenced by other sources.

Source: Provided by ENSR in 2008.

exceed State of California health-based MCLs; leaching of TBA at levels that, at least initially, exceed the California notification and response levels; and that may or may not leach certain Proposition 65 chemicals at levels that exceed Safe Harbor or other levels authorized by Proposition 65 and the regulations implementing Proposition 65, this would represent a **potentially significant** impact.

Mitigation Measure 4.4-1: Noncompliance with Drinking Water Standards Resulting from Leaching.

NSF certifies that each formulation of PEX tubing for potable water with the marking "NSF ®-pw" has met the NSF 61 standards for drinking water. Every PEX formulation from each manufacturer is tested before certification. Before using PEX for human consumption uses, PEX must receive NSF certification that any leached concentrations of MTBE, TBA, or Proposition 65 chemicals is below the relevant MCL, notification, or Safe Harbor level or other applicable Proposition 65 level for those chemicals. The Building Standards Commission shall require that PEX installed in California for water for human consumption be physically marked in a manner that indicates that the pipe is certified for California human consumption water uses and meets all California drinking water criteria under the California Safe Drinking Water Act and Proposition 65.

Significance after Mitigation: Adoption of Mitigation Measure 4.4.1 would reduce potential impacts relative to leaching of MTBE, TBA, or Proposition 65 chemicals to **less than significant** levels.

IMPACT 4.4-2 Water Quality—Adverse Taste and Odor Impacts. *The proposed project would result in the increased use of PEX tubing in California, 25.4% of which exceeds the secondary MCL for MTBE for taste and odor set by DPH. Thus, a substantial number of people would be affected by unpleasant tastes and odors in drinking water on a frequent basis. This is a* ***significant*** *impact.*

The occurrence and severity of taste and odor impacts depend on numerous factors, including the nature, frequency, and intensity of the source. Although offensive tastes and odors rarely cause any physical harm, they can be unpleasant, leading to considerable distress and often generating citizen complaints to local governments and regulatory agencies. With respect to the proposed project, installation of PEX could lead to leaching or permeation of chemicals into drinking water. Presence of certain chemicals in drinking water can lead to unpleasant odor and taste of water as perceived by the user. Water utilities strive to provide drinking water that does not have unpleasant taste and odor. DPH sets primary MCLs for drinking water to protect public health, and secondary MCLs to address aesthetic properties of drinking water. Table 4.4-5 below summarizes taste and odor standards and potential for use of PEX to affect taste and odor of drinking water.

The proposed project could result in the leaching of chemicals into drinking water that affect taste and odor. NSF testing data provided in the record demonstrate that PEX is known to leach MTBE in concentrations that would exceed the secondary MCL for MTBE. However, there is no other chemical for which quantitative evidence of exceedance of a secondary MCL exists. Based on the exceedances of the secondary MCL, as documented by NSF, the impacts on the aesthetic properties of drinking water (taste and odor) would be **significant**.

**Table 4.4-5**
**Potential Chemicals Present in Drinking Water Transported through PEX Tubing and Secondary Maximum Contaminant Level Standards**

| Substance | NSF Standard for PEX | PEX Performance | Secondary MCL | Perceived Taste or Odor |
|---|---|---|---|---|
| MTBE | 50 ppb | 25.4% of pipe exceeds 5 ppb | 5 ppb | turpentine |
| bisphenol-A | 0.1 ppm | > 0.1 ppm | - | medicinal |

Note:
MCL = maximum contaminant levels; MTBE = methyl tertiary-butyl ether; ppb = parts per billion; ppm = parts per million
Source: California Safe Drinking Water Act and Related Laws and Regulations (Title 22, California Code of Regulations, Section 64448); Tomboulian et al. 2004; data provided by ENSR in 2008.

Mitigation Measure 4.4-2: Adverse Taste and Odor Impacts.

Before using PEX for human consumption water uses, PEX must receive NSF certification that any leached concentrations of MTBE is below the secondary California MCL for this chemical. PEX manufacturers claim that MBTE and TBA levels leached from PEX decline over time. They may pursue testing by NSF to determine whether the levels decline to below California criteria within a limited time.

Significance after Mitigation: Adoption of Mitigation Measure 4.4.2 would reduce taste and odor impacts on drinking water from leaching MTBE to **less than significant**.

IMPACT 4.4-3 Water Quality—Noncompliance with Drinking Water Standards Resulting from Permeation. *In cases where PEX is placed below the slab where contaminated soils are present and permeated by solvents or gasoline, it has the potential to introduce chemicals into drinking water at levels in exceedance of federal and California MCLs, notification and response levels, or the Proposition 65 Safe Harbor levels, as well as to introduce Proposition 65 chemicals for which there are no adopted federal or California standards. Because the project would allow the use of PEX for hot and cold water distribution including potable water uses and the proposed regulations provide no restriction on uses below the slab this project could result in a* potentially significant *impact.*

## Summary of Case Reports of Permeation

Lee (1985) discussed several case histories of permeation of plastic pipes by organic compounds in the environment. The East Bay Municipal Utility District in Oakland, California reported four instances of apparent petroleum distillate penetration of polybutylene (PB) water service lines. A case in Maryland was reported in which concentrations up to 5,500 µg/L of toluene were found in a water sample collected from a service line consisting of both PE and PB. The soil surrounding the service line was contaminated with gasoline as a result of a leaking underground storage tank. The Alabama Department of Environmental Management reported permeation of PB service pipes with diesel fuel. In another incident, a private residence in Chattanooga, Tennessee reported that gasoline had leaked from the resident's car in the vicinity of a three-quarter-inch PE service line and permeated the service line. A similar incident occurred in Darien, Connecticut where a resident complaint of gasoline odor in tap water resulted in sample analysis which showed benzene (>100 µg/L) and toluene (>50 µg/L) in the tap water. The odors were absent after flushing and when the homeowners' plumbing was in daily use. Samples collected after the system had not been used for 2 days contained approximately16 µg/L benzene and a gasoline odor. The resident's 1¼-inch PE service line was replaced with copper after it was determined that an abandoned underground gasoline storage tank on the resident's property had developed a leak and saturated the ground surrounding the line. Although PB, PE, and PEX are all members of the polyolefin family, this does not mean that PEX will automatically behave similarly to PB and PE. However, there is a lack of data regarding how PEX may behave differently from other members of the polyolefin family when it comes to issues of permeability.

## Permeation by Various Organic Compounds

Lee (1985) also discussed a research investigation carried out by the American Water Works Service Company to determine the extent and nature of permeation of several different organic compounds through the types of service lines in use in the American Water Works system. Five pipe materials were used—iron, copper, PE, PB, and PVC. The conditions of exposure were designed to simulate worst-case field conditions. One exposure tank involved exposure of the five piping materials to a vapor environment. The second exposure tank involved exposure of the five piping materials to a moist soil environment to which sufficient chemical was added; the pipe was above the saturated soil, but still within the moist capillary zone. Three organic compounds were investigated in each exposure tank—gasoline, trichloroethylene (TCE) and chlordane. The pipes were in contact separately with the three organic compounds for a minimum 10-week exposure period. The pipes were unjointed three-quarter-inch lines filled with tap water. Water samples were analyzed at four intervals during the exposure period. The results were reported as follows:

- Iron and copper pipes were not permeated by any of the organic compounds in either the soil or the vapor environments.

- PE pipe was permeated by TCE within 1 week in both the soil and vapor exposure conditions. Gasoline permeation occurred within 1 day in the vapor and 3 weeks in the soil exposure. Chlordane did not permeate the polyethylene pipe in either the soil or vapor exposure condition.

- Chlordane did not permeate the polybutylene and PVC pipes. Both types of pipes showed permeation of TCE and gasoline in both the soil or vapor exposure conditions.

The study authors concluded that plastic pipe is susceptible to permeation from certain organic compounds, particularly solvents. Based on these results, the authors recommend that limitations are desirable in areas where the potential for soil contamination is high, such as a gasoline storage area.

### Theoretical Calculations of Permeation

In his analysis report, Hoffmann (2005) conducted theoretical calculations on the length of time that would be required for an organic compound to permeate through the walls of PEX pipe. He estimated the characteristic time for diffusion of a compound through PEX pipe with a wall thickness of 0.5 centimeter (0.2 inch) and a diffusion coefficient of 1.0 x 10–12 centimeters squared per second to be 8,000 years. The diffusion coefficient used by Hoffmann appears to be representative of termiticides (he lists six representative termiticides—bifenthrin, chlorpyrifos, cypermethrin, fenvalerate, imidachoprid, and permethrin). However, Hoffmann does not comment on the experimental results of Lee (1985) where the author found that PE pipe was permeated by both TCE and gasoline (in both the soil and vapor phase) within several weeks. Lee (1985) found that chlordane did not permeate any of the pipes. Therefore, it is possible that Hoffmann's theoretical calculations apply only to organic compounds that are termiticides or pesticides (such as chlordane). However, his calculations may not apply to solvents, such as gasoline or TCE, which appear to have much faster permeation rates through plastic pipes based on the experimental results reported in Lee (1985).

### Permeation by Solvents, Gasoline, Pesticides, and Termiticides

Evidence shows that use of PEX tubing should be restricted under certain soil conditions and, in fact, manufacturers recommend restrictions in certain instances. (Vanguard Piping Systems, Inc. 2000:19.) Manufacture installation handbooks regularly provide warnings such as "must not be installed underground in areas of known chemical contamination of the soil, such as organic solvents or petroleum distillates, or where there is a high risk of chemical spills." (Id.) A permeation study showed that polyethylene pipe was permeated by both TCE and gasoline (in both the soil and vapor phase) within several weeks. Chlordane was also tested for permeation; however, polyethylene pipe was not permeated by chlordane. The same study also tested iron and copper pipes, which were not permeated by any of the organic compounds in either the soil or the vapor environments. The study authors concluded that plastic pipe is susceptible to permeation by certain organic compounds, particularly solvents. Based on these results, the authors recommend that limitations are desirable in areas where the potential for soil contamination is high, such as a gasoline storage area. Theoretical calculations on permeation of termiticides indicated that these types of organic compounds would not permeate PEX piping (Hoffmann 2005). Therefore, termiticides or pesticides are less likely to permeate PEX piping, and do not represent a concern. However, compounds such as gasoline and chlorinated solvents could present concerns for permeation.

As discussed above, in cases where PEX is placed in contaminated soils and permeated by solvents or gasoline, it has the potential to introduce chemicals into drinking water at levels far in exceedance of federal and state MCLs. Because the project would allow the use of PEX for hot and cold water distribution including potable water uses and the proposed regulations provide no restriction on uses below the slab (i.e. under the house) this project could result in a **potentially significant** impact.

Mitigation Measure 4.4-3: Noncompliance with California and Federal Drinking Water Standards (including Proposition 65) Resulting from Permeation.

The regulation shall require the installation of PEX for potable water uses above the slab unless:

- a Phase 1 Environmental Site Assessment is conducted following the ASTM E1527-05 standard, for every project that would use PEX below the slab, which concludes that contamination of the soils or groundwater in areas where PEX tubing would be placed or could be reasonably permeated by nearby contamination with solvents or gasoline is unlikely; or,

- The PEX is sleeved by a metal or other material that is impermeable to solvents and petroleum products.

A "project" subject to the Phase I assessment requirement could be anything from a single housing unit to a project of several thousand units of housing. So for a project of one unit or of multiple units, only one Phase I assessment would be required for the entire project. A Phase I Environmental Site Assessment, often referred to as "environmental due diligence," is used by purchasers and lenders to evaluate a property for potential environmental contamination and to assess the potential liability for contamination present at the property. Compliance with ASTM E1527-05 standards would include:

- review of federal, state, and local environmental databases;

- interviews with local environmental oversight agencies and interviews with property owners and/or other interested party(ies);

- review of historical building permits, historical insurance (Sanborn) maps, historical city directories, historical topographic maps, and historical aerial photographs;

- inspection of subject property and surrounding areas;

- research of public agency records pertaining to historical land use (e.g., GeoTracker database); and

- conclusions regarding the presence or potential presence of environmental liabilities at the subject property.

The conclusions will include a determination regarding the likelihood of the presence of solvents or gasoline in soils on the property. This will provide adequate assurance that the property is not contaminated with solvents or gasoline.

Significance after Mitigation: Adoption of Mitigation Measure 4.4-3 would ensure that potential impacts on compliance with Drinking Water Standards resulting from permeation are reduced to **less than significant**.

## 4.4.4 Significant and Unavoidable Impacts

Because all potentially significant and significant impacts would be reduced to less than significant with the implementation of mitigation, no water quality impacts would be significant and unavoidable.

# 5 CUMULATIVE IMPACTS

## 5.1 INTRODUCTION

California Environmental Quality Act (CEQA) Guidelines (State CEQA Guidelines), Section 15130, require that an environmental impact report (EIR) discuss cumulative impacts of a project and determine if the project's incremental effect is "cumulatively considerable." The definition of cumulatively considerable is provided in Section 15065(a)(3):

> "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.

According to Section 15130(b) of the State CEQA Guidelines:

> "[t]he discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great detail as is provided for the effects attributable to the project alone. The discussion should be guided by standards of practicality and reasonableness, and should focus on the cumulative impact to which the identified other projects contribute rather than the attributes of other projects which do not contribute to the cumulative impact."

For purposes of this EIR, the project would have a significant cumulative effect if:

- The cumulative effects of related projects (past, current, and probable future projects) without the project are not significant and the project's incremental impact is substantial enough, when added to the cumulative effects, to result in a significant impact.

- The cumulative effects of related projects (past, current, and probable future projects) without the project are already significant and the project contributes measurably to the effect. The standards used herein to determine measurability are that either the impact must be noticeable or must exceed an established threshold of significance.

- The cumulative effects of related past environmental impacts added to project's incremental impacts results in a significant impact.

Mitigation measures are to be developed, where feasible, that reduce the project's contribution to cumulative effects to a less-than-significant level.

This draft EIR (DEIR) identified potentially significant and significant environmental impacts associated with implementation of the proposed project; those impacts are addressed in Chapter 4, "Affected Environment, Thresholds of Significance, Environmental Impacts, and Mitigation Measures."

## 5.2 RELATED PROJECTS AND PAST ENVIRONMENTAL IMPACTS

The analysis of cumulative environmental impacts associated with the project addresses the potential incremental impacts of the project in combination with those of other past, present, and probable future projects. For the purposes of this analysis, the chlorinated polyvinyl chloride (CPVC) plastic plumbing pipe project is a related past project.

The Adoption of Regulations Permitting Statewide Residential Use of CPVC Plastic Plumbing Pipe (CPVC) project is the adoption of regulations (i.e., building standards) pertaining to the use of CPVC pipe for potable water plumbing applications in a variety of structures including hotels, motels, apartment houses, condominiums, and shelters for homeless persons. The lead agency for the CPVC project was the State of California Department of Housing and Community Development (HCD). The regulations were recently approved, and became effective January 1, 2008, and are now part of the California Plumbing Code (CPC) (HCD 2006:11).

PEX tubing is currently used in California for hydronic heating systems, all uses including potable water in manufactured homes, use as an alternate material in nearly 200 California cities and nearly 30 California counties, and all uses in three cities that have approved its use by ordinance (see Chapter 3, “Description of the Proposed Project”). Implementation of the proposed project would increase the use of PEX tubing for potable water applications, with a proportionate decrease in the use of other piping materials (such as copper). It is assumed that the proposed project would increase the estimated percentage use of PEX tubing in California from approximately 37% to 45% because of the reduced labor costs associated with installation of PEX and because of corrosivity issues with copper piping resulting from the increased use of chloramines for drinking water disinfection (see Section 3.4.4, “Current and Projected Uses of PEX”).

Without considering the potential approval of the statewide use of PEX tubing, adoption of the CPVC project was projected to increase the estimated percentage use of CPVC piping in California from approximately 13% to 30% and proportionately decrease the use of other plumbing materials (HCD 2006b). Because both the CPVC project and the proposed PEX project will result in more plastic plumbing materials being used in California, the CPVC project is a relevant related past project and will be considered in the following cumulative impact analysis.

The analysis of cumulative environmental impacts associated with the project also addresses the potential incremental impacts of the project in combination with those of past environmental impacts. For the purposes of this analysis, the presence of methyl tertiary butyl ether (MTBE) or tertiary butyl alcohol (TBA) in drinking water sources is considered a past environmental impact.

MTBE has been detected in a number of drinking water sources in California at levels greater than MTBE’s California primary MCL of 0.013 mg/L and secondary MCL of 0.005 mg/L. In addition, MTBE has been detected in drinking water sources at levels less than 0.005 mg/L (CDPH 2006). As described in Impact 4.4-1 (see Section 4.4, “Water Quality”), testing indicates that a proportion of PEX tubing has been associated with leaching levels of MTBE and TBA at levels exceeding the California primary and secondary MCLs for MTBE and exceeding the California notification and response levels for TBA.

## 5.3 ANALYSIS OF CUMULATIVE IMPACTS

The following sections contain a discussion of the cumulative effects anticipated from project implementation along with the related CPVC project and MTBE and TBA contamination for each of the four environmental issue areas evaluated in Chapter 4 of this DEIR. The analysis conforms with Section 15130 of the State CEQA Guidelines, which specifies that the “discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great detail as is provided of the effects attributable to the project alone.”

### 5.3.1 AIR QUALITY

#### CRITERIA AIR POLLUTANT AND TAC EMISSIONS

Criteria air pollutants include ozone, carbon monoxide (CO), nitrogen dioxide, sulfur dioxide, fine particulate matter, respirable particulate mater ($PM_{10}$), and lead. Ozone is a photochemical oxidant, a substance whose oxygen combines chemically with another substance in the presence of sunlight. Hydrocarbons are organic gases that are formed solely of hydrogen and carbon. There are several subsets of organic gases including volatile organic compounds (VOCs) and reactive organic gases (ROGs). Certain VOCs are considered ROGs. ROGs and oxides of nitrogen ($NO_X$) are emitted primarily by mobile sources and stationary combustion equipment. Another source of hydrocarbons is evaporation from petroleum fuels, adhesives, solvents, dry cleaning solutions, paint, primer, and cement. ROG emissions combine with $NO_X$ to form ozone. ROG and $NO_X$ are therefore ozone precursors. Adhesives and solvents can evaporate and react with other chemicals to form ozone. Because installation and repair of PEX tubing would not require the use of adhesives or solvents (i.e., ROGs), would not require soldering (which is a source of $PM_{10}$), and PEX tubing is not manufactured in the State of California, the proposed project would not increase emissions of ozone precursors (e.g., ROGs and $NO_X$), lead, sulfur oxides, CO, or PM in California. Thus, criteria air pollutant impacts would not occur and the project would not combine cumulatively with the CPVC project to result in any significant criteria air pollutant impacts. In addition, the project would not result in or contribute to cumulative toxic air contaminant (TAC) impacts. Compared to copper, the transportation of lighter weight PEX tubing would reduce truck transport emissions of ROGs, PM, and diesel PM (a TAC).

Because the proposed project would not emit any criteria air pollutants and would not result in an increased risk of exposure of sensitive receptors to TAC emissions, cumulative impacts would be **less than significant**, and the proposed project's contribution would not be cumulatively considerable.

### PEX and CPVC Incineration

Upon incineration in the event of a structure fire, plastic piping materials (including PEX and CPVC) could release chemicals considered TACs, which could then pose a health hazard to the public or emergency personnel. As described in Section 4.1, "Air Quality," the expanded use of all types of plastics as well as other building materials and contents and the products of combustion generated by these materials in the fire environment creates an increasingly toxic environment within a burning structure. However, common materials and products made from wood and other organic fibers also produce toxic products of combustion hazardous to the health of humans. The quantity of plastic tubing is relatively insignificant when compared to all the other materials within a typical structure. It takes about 500 feet of PEX with a total weight of approximately 65 pounds (similar to the weight of a typical coffee table) to plumb an average single family home. Therefore, the added toxic products of combustion generated by PEX tubing (or CPVC) in a fire would be comparatively minor, and testing and field data indicate that gases emitted from plastic piping are no more toxic than other common building and furnishing materials found in structures (such as carpeting, electronics, insulation, and wood). The extent to which plastic tubing would contribute to this risk would be minor in comparison to the total, and additionally, structure fire would be considered an anomaly and not part of the baseline under CEQA.

The impacts associated with TAC emissions from incineration of plastic plumbing materials (including PEX and CPVC) as a result of a structure fire would be **less than significant**, and the project's contribution would not be considerable.

### Climate Change

An individual project cannot generate enough greenhouse gas (GHG) emissions to significantly influence global climate change. The project participates in this potential impact by its incremental contribution, combined with the cumulative contributions of all other sources of GHGs, which, when taken together, cause global climate change impacts. Subsections 4.1.1 and 4.1.2 of Section 4.1, "Air Quality," provide a discussion of the existing physical and regulatory setting related to climate change and GHG emissions.

Because no thresholds of significance or methods of analysis of GHG emissions are adopted or recommended, an appropriate approach is to examine the proposed project in context relative to existing conditions. The following discussion reviews the proposed project's potential generation of GHGs and its incremental contribution to the cumulative effect resulting from emissions of GHGs.

PEX tubing is already being produced at manufacturing facilities outside of California. Industrial sources of GHG emissions made up 4.6% of the total United States GHG emissions inventory in 2005 (EPA 2007:12). The proposed project would generate GHG emissions associated with increased demand for PEX as it would replace other approved plumbing materials in California. According to a life cycle assessment for production of plumbing materials, PEX pipe was estimated to result in approximately 370 pounds of carbon dioxide ($CO_2$) equivalent (a measurement used to normalize the global warming potential of all GHGs to that of an equivalent mass of $CO_2$) per 1,000 feet of water pipe produced (PPFA 2007:75). CPVC pipe was estimated to result in approximately 425 pounds of $CO_2$ equivalent, and copper tubing was estimated to result in more than 700 pounds of $CO_2$ equivalent. Because plumbing pipe production is a function of market demand, the proposed project would not increase the overall demand for plumbing pipe in the marketplace. Rather, PEX would be used in place of some other existing allowable material. In California, copper tubing currently constitutes the majority of the existing market share in plumbing materials. However, the market share for copper tubing would decrease as the market share for PEX tubing and CPVC pipe increase.

The proposed project would result in a reduction in GHG emissions associated with pipe production as compared with the existing condition, which was estimated to result in substantially higher GHGs emissions over the life cycle. Increased CPVC market share would also result in a reduction in GHG emissions associated with pipe production as compared to the existing condition. The proposed project would not result in a substantial increase in GHG emissions relative to existing conditions, and would not result in a cumulatively considerable contribution to the impact of global climate change, and this impact would be **less than significant**.

## 5.3.2 Public Health and Hazards

### Biofilm, Fire Ignition Risk, Fire Spread Risk, and Worker Safety Hazard Impacts

Biofilm growth, fire ignition and spread risk, premature PEX failure leading to formation of mold and worker safety hazards are concerns that have been raised regarding the proposed project and the CPVC project. However, impacts related to biofilm growth, fire ignition and spread risk, and worker safety hazards are considered less than significant under the project because:

- PEX does not have increased levels of biofilm as compared to copper beyond the first 200 days of use and, even if it did, biofilm growth does not correspond to higher amounts of *Legionella* bacteria and the project would not lead to increased risk of human contact with a pathogenic bacteria;

- PEX is not particularly flammable and the project would conform to applicable CPC requirements and design and installation guidelines which are protective against potential fire spread hazards; and

- the proposed project does not require the use of solvents, glues, or open flames during installation.

Because the project's biofilm, fire spread risk, and safety hazard impacts would be less than significant, no mitigation measures are required and no significant public health or hazards impacts would occur. Because the CPVC project would also conform to applicable CPC requirements and design and installation guidelines, and because safety hazards associated with the CPVC project are less than significant (HCD 2006:ES), these impacts would be considered **less than significant** both on an individual project and cumulative basis, and the project's contribution would not be considerable.

### Premature PEX Failure, Flooding and Potential Mold Impacts

As discussed in Section 4.2, "Public Health and Hazards," the impact associated with risk of premature or unexpected PEX failure potentially increasing the incidence of mold would be potentially significant because the ASTM F2023 testing standard does not test for continuously recirculating hot chlorinated water. However, this impact would be mitigated to less-than-significant levels through the Building Standards Commission's adoption of regulatory language requiring certification using the NSF P171 CL-R standard or a yet-to-be adopted equally rigorous standard that assumes 100% continuously recirculating chlorinated hot water, would ensure a conservative product lifetime of 40 years and is approved by the Building Standards Commission for testing PEX for continuously recirculating hot chlorinated water. The CPVC project must also meet applicable testing standards; therefore, additive effects would not result from the combination of the CPVC project and the proposed project.

Implementation of the project with the proposed mitigation would not create increased risk of premature PEX failure and would not result in any cumulatively considerable incremental contributions to any significant cumulative impacts. This would be a **less-than-significant** cumulative public health and hazard impact, and the project's contribution would not be considerable.

## 5.3.3 SOLID WASTE

Similar to the proposed PEX tubing project, the approval of CPVC for statewide potable water use would be expected to increase the volume of plastic tubing debris requiring disposal. Plastic tubing debris would be generated when CPVC and PEX tubing is replaced in an existing structure, when CPVC and PEX tubing is installed in a structure, and when various types of buildings and structures containing PEX and CPVC tubing are demolished. Assuming plastic pipes and fittings represent 100% of all durable plastic items in the construction and demolition waste stream, and PEX and CPVC tubing represent 100% of all plastic pipes and fittings, PEX and CPVC tubing would represent up to 0.04% of the waste placed in landfills annually. Although PEX is not currently recyclable, some amount of PEX tubing could be diverted and sold for other uses such as composite lumber, nonpressure irrigation, or filler in cement and asphalt. CPVC is recyclable, and it would be reasonable to assume that some CPVC would be diverted in the future. Therefore, the maximum amount of PEX and CPVC solid waste generated annually would not be substantial in relation to the total amount of landfilled solid waste.

Although implementation of the proposed project, in combination with increased CPVC plastic tubing debris, would be expected to increase the volume of plastic debris requiring disposal, because the amount of PEX and CPVC solid waste generated annually would not be substantial in relation to the total amount of landfilled solid waste, this would be a **less-than-significant** cumulative impact, and the project's contribution would not be cumulatively considerable

## 5.3.4 WATER QUALITY

### LEACHING IMPACTS

As discussed in Section 4.4, "Water Quality," the proposed project would result in potentially significant leaching and permeation impacts, as well as significant taste and odor impacts. Because testing indicates that a proportion of PEX tubing has been associated with the leaching of levels of methyl tertiary-butyl ether (MTBE) and tertiary butyl alcohol (TBA) at levels exceeding California drinking water standards, and because PEX has the potential to leach Proposition 65 chemicals in concentrations higher than allowed under Proposition 65 and its implementing regulations, leaching impacts would be potentially significant. In addition, testing indicates that a proportion of PEX tubing has been associated with levels of MTBE at levels exceeding the California secondary maximum contaminant levels (MCL) for taste and odor; this would be a significant impact. However, these impacts would be mitigated to less-than-significant levels by ensuring that, before using PEX tubing for potable water uses, it receives NSF certification that any leached concentrations of MTBE, TBA, or Proposition 65 chemicals are below the relevant California MCL, California secondary MCL, California notification level, Proposition 65 Safe Harbor, or other relevant Proposition 65 levels for those chemicals. The CPVC project must also meet applicable testing standards for leachates; therefore, additive effects would not result from the combination of the CPVC project and the proposed project.

Because the proposed project and the CPVC project must meet applicable testing standards for leachates, this would be a **less-than-significant** cumulative water quality impact, and the project's contribution would not be considerable.

### PERMEATION IMPACTS

The proposed project would also have potentially significant permeation impacts. In cases where PEX is placed below the slab where contaminated soils are present and permeated by solvents or gasoline, PEX has the potential to introduce chemicals into drinking water at levels in exceedance of federal and state MCLs. Because the project would allow the use of PEX tubing and the proposed regulations provide no restriction on uses below the slab (i.e., in the ground), permeation impacts would be potentially significant. However, this impact would be mitigated to a less-than-significant level by prohibiting the installation of PEX for potable water uses below the slab unless a Phase I Environmental Site Assessment for the project is conducted following the ASTM E1527-05 standard, demonstrating that the soil is clean or, that the pipe is sleeved using a metal or other material that is impermeable to solvents and petroleum products.

Because permeation impacts are not associated with CPVC piping, additive effects would not result from the combination of the CPVC project and the proposed project. Additionally, the potentially significant impact of permeation would be mitigated to a less-than-significant level by prohibiting the installation of PEX for potable water uses below the slab unless a Phase I Environmental Site Assessment for the project is conducted following the ASTM E1527-05 standard, demonstrating that the soil is clean or, that the pipe is sleeved using a metal or other material that is impermeable to solvents and petroleum products and so would not combine with past impacts of contaminated soils or groundwater. This would be a **less-than-significant** cumulative water quality impact, and the project's contribution would not be considerable.

### ADDITIVE MTBE AND TBA IMPACTS

The use of PEX tubing for human consumption uses has the potential to contribute to drinking water contamination from MTBE or TBA  when used in combination with certain environmental conditions. MTBE has been detected in a number of drinking water sources in California at levels greater than MTBE's California primary MCL of 0.013 mg/L and secondary MCL of 0.005 mg/L. In addition, MTBE has been detected in several drinking water sources at levels less than 0.005 mg/L. Levels of MTBE or TBA in drinking water could combine with MTBE or TBA leached from PEX tubing at levels exceeding the California primary and secondary MCLs. The Building Standards Commission Regulation will include a prohibition on using PEX in buildings served by water sources with known MTBE and/or TBA contamination such that anticipated MTBE or TBA leaching from PEX in combination with existing water contamination would cause chemicals in the water to exceed California primary or secondary MCL drinking water standards.

The use of PEX tubing for human consumption uses has the potential to contribute to drinking water contamination from MTBE or TBA when used in combination with certain environmental conditions. This impact has the greatest potential to occur where the source water (either well water or water from a public water provider) also contains those contaminants. In that case, depending on the situation, the water served by a public water provider or a well, for example, could contain a level of a contaminant, such as MTBE, that does not exceed the MCL. However, combined with the MTBE from PEX, also below the California MCL for MTBE, the MCL could be exceeded, even though the contribution from PEX is individually insignificant. Therefore, the cumulative impact on drinking water from chemicals leaching from PEX in combination with certain environmental conditions would be **significant**, and the project's contribution would be potentially cumulatively considerable.

Mitigation Measure 5-1: Cumulative Noncompliance with Drinking Water Standards Resulting from Leaching.

For water service areas that have detectable levels of MTBE or TBA in drinking water or where there is known MTBE or TBA contamination of a source of drinking water, PEX tubing installed for human consumption uses must be certified not to leach detectable levels of MTBE or TBA.

Significance after Mitigation: Adoption of Mitigation Measure 5-1 would prevent any cumulatively considerable contribution of MTBE or TBA from PEX and would reduce this impact to **less than significant**.

# 6 OTHER CEQA SECTIONS

## 6.1 GROWTH INDUCEMENT

### 6.1.1 CALIFORNIA ENVIRONMENTAL QUALITY ACT GUIDELINES

California Environmental Quality Act (CEQA) Guidelines (State CEQA Guidelines) Section 15126(d) specifies that growth-inducing impacts of a project must be addressed in an environmental impact report (EIR) and states that a proposed project is growth-inducing if it could “foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment.” Included in the definition are projects that would remove obstacles to population growth. Examples of growth-inducing actions include developing water, wastewater, fire, or other types of services in previously unserved areas, extending transportation routes into previously undeveloped areas, and establishing major new employment opportunities. The following is a summary of the direct and indirect growth-inducing impacts that could result with implementation of the project.

### 6.1.2 GROWTH-INDUCING IMPACTS OF THE PROJECT

The proposed project is the adoption of regulations (i.e., building standards) pertaining to the use of PEX tubing. Implementation of the proposed project would allow the statewide use of PEX tubing for hot and cold water (including potable water) distribution under the jurisdiction of state responsible agencies. The proposed PEX tubing regulations would apply to all occupancies, including commercial, residential, and institutional building construction, rehabilitation, and repair in all areas of the state. Because the proposed project is a statewide regulatory change, the project area includes the entire State of California. Therefore, this draft EIR (DEIR) does not evaluate a specific project that involves direct construction or modification to structures.

It is likely that, because of the reduced costs of PEX installation compared to copper, there would be some cost savings for homebuilders and homeowners who are repiping existing residential structures due to the reduced costs of PEX installation compared to copper; cost of the material is not substantially different. Although use of PEX tubing may be less expensive than copper pipe, this cost savings would not, in and of itself, be so substantial that it would provide the resources for builders to produce additional housing, or cause economic, or population growth. Many other factors (e.g., cost and availability of land, labor, other building materials, economic climate, land use designations) contribute to the rate of growth and construction in a given community. In addition, the project is not expected to eliminate any obstacles to growth (as might result, for example, from a change in the general plan designation of zoning of real property), or to induce or accommodate growth (as might result, for example, from the construction of new water or wastewater infrastructure).

## 6.2 SIGNIFICANT IRREVERSIBLE ENVIRONMENTAL CHANGES

### 6.2.1 CALIFORNIA ENVIRONMENTAL QUALITY ACT GUIDELINES

CEQA Section 21100 (b)(2) states that an EIR shall include a detailed statement setting forth “[i]n a separate section…[a]ny significant effect on the environment that would be irreversible if the project is implemented.” Specifically, CEQA Section 21100.1(a) requires that a discussion of significant irreversible environmental effects be included in an EIR prepared in connection with “[t]he adoption, amendment, or enactment of a plan, policy, or ordinance of a public agency.” Because the project is the adoption of state plumbing code regulations by the California Building Standards Commission that would allow the statewide use of PEX tubing, a discussion of significant irreversible environmental changes is provided in this section.

State CEQA Guidelines Section 15126.2(c) provides the following guidelines for analyzing the significant irreversible environmental changes of a project:

> Uses of nonrenewable resources during the initial and continued phases of the project may be irreversible because a large commitment of such resources makes removal or nonuse thereafter unlikely. Primary impacts and, particularly, secondary impacts (such as highway improvements which provide access to a previously inaccessible area) generally commit future generations to similar uses. Also irreversible damage can result from an environmental accident associated with the project. Irretrievable commitments of resources should be evaluated to assure that such current consumption is justified.

### 6.2.2 IRREVERSIBLE ENVIRONMENTAL CHANGES OF THE PROJECT

The irreversible and irretrievable commitment of resources is the permanent loss of resources for future or alternative purposes. Irreversible and irretrievable resources are those that cannot be recovered or recycled or those that are consumed or reduced to unrecoverable forms.

Natural resources include minerals, energy, land, water, forests, and biota. Nonrenewable resources are those resources that cannot be replenished by natural means, including oil, natural gas, and iron ore. Renewable natural resources are those resources than can be replenished by natural means, including water, lumber, and soil.

As described in Chapter 3, “Description of the Proposed Project,” PEX is a form of plastic tubing. The materials used in the production of plastics are natural products such as cellulose, coal, natural gas, salt, and crude oil. Crude oil is a complex mixture of thousands of compounds. To become useful, it must be processed. There are many different types of plastics, and they can be grouped into two main polymer families: thermoplastics (which soften when heated and then harden again when cooled) and thermosets (which never soften when they have been molded). PEX is made of polyethylene (PE), which is a thermoplastic. PEX is a member of the polyolefin family of polymers along with normal PE, high-density polyethylene, polypropylene, and polybutylene. Polyolefins are produced from oil or natural gas. Because the materials used in the production of PEX are nonrenewable resources, PEX production would be an irreversible and irretrievable commitment of these resources. However, the proposed project would not noticeably increase the overall rate of use of any natural resource, or result in the substantial depletion of any nonrenewable natural resource.

Plastics manufacturing worldwide accounts for approximately 4% of the world’s crude oil use (Centre for Ecological Studies 2008.) The amount of crude oil used to make PE varies between 1.55 and 1.95 kg/kg. PEX is cross-linked PE (Centre for Ecological Studies 2008.) Assuming an average of 1.75 kg per kg, it would take a little less than 29 kg of crude oil to make enough PEX to plumb a single family home. There are approximately 73.47 million barrels of crude oil produced worldwide on an annual basis (Energy Information Administration 2008). One barrel of crude oil weighs 138.8 kg and would produce enough PEX to plumb nearly 5 single family homes. In 2007 approximately 112,000 new homes and apartments were built, approximately 37% of those units (approximately 41,440 units) were plumbed with PEX (HCD 2008, Ash, pers. comm., 2008). It is expected that with approval of the proposed project, this percentage will increase to about 45% of units or an increase of about 8,960 units a year. Therefore, this project would result in an increase in crude oil use of about 1,872 barrels per year which is less than a .0001% increase in crude oil use. Additionally, copper production is energy intensive and likely uses a certain amount of fuel from crude oil, though data on this was unavailable. Therefore, 1,872 barrels per year is a gross and not a net increase in oil use from PEX. The actual increase would be lower, assuming that an increase in PEX production would correspond with a proportional decrease in copper production. Therefore, the commitment of nonrenewable natural resources to increased PEX production would be minimal and would not be a significant irreversible environmental change.

As described in Section 4.3, “Solid Waste,” PEX recycling is hampered by the cross-linking of the PE molecules. Cross-linked plastics like PEX are known as “thermoset” plastics and cannot be remelted or remolded.
This makes PEX very difficult to recycle. However, PEX can be ground down and used as filler in another

material. PEX manufacturers are establishing markets for clean ground manufacturing and installation scrap and are selling it for other uses such as composite lumber (used in decking and fences), irrigation tubing, and filler in cement and asphalt. Increased PEX production would be an irreversible and irretrievable commitment of nonrenewable natural resources because PEX is a cross-linked thermoset plastic and cannot be recycled. However, the proposed project would not noticeably increase the overall rate of use of any natural resource, or result in the substantial depletion of any nonrenewable natural resource. Therefore, the commitment of nonrenewable natural resources to a nonrecyclable plumbing product would not be a significant irreversible environmental change.

In addition, the proposed project is not anticipated to result in irreversible damage from environmental accidents involving hazardous materials, such as accidental spills of solvents or propane, because the installation and repair of PEX tubing would not require the use of adhesives, solvents, or soldering. While it is possible than an accident could occur at a PEX tubing construction site, the proposed project would not result in a substantial increase in accident risk. In the State of California, the storage and use of hazardous substances are strictly regulated and enforced by various local and regional agencies. The enforcement of these existing regulations would preclude credible significant project impacts related to environmental accidents.

# 7 ALTERNATIVES TO THE PROJECT

The California Environmental Quality Act (CEQA) Guidelines (State CEQA Guidelines) (Section 15126.6[a]) require evaluation of “a range of reasonable alternatives to the project, or the location of the project, which would feasibly attain most of the basic project objectives but would avoid or substantially lessen any of the significant effects, and evaluate the comparative merits of the alternatives.” The purpose of the alternatives analysis is to determine whether or not a variation of the project would reduce or eliminate significant project impacts, within the basic framework of the objectives.

Thus, alternatives considered in an environmental impact report (EIR) should be feasible and should attain basic project objectives. As described in Section 3.3, “Project Objectives,” the objective of the proposed project is to provide an alternative hot and cold water plumbing material for use in California.

## 7.1 RANGE OF ALTERNATIVES CONSIDERED

The range of alternatives studied in the EIR is governed by the “rule of reason,” requiring evaluation of only those alternatives “necessary to permit a reasoned choice” (State CEQA Guidelines Section 15126.6[f]). Further, an EIR “need not consider an alternative whose effect cannot be reasonably ascertained and whose implementation is remote and speculative” (State CEQA Guidelines Section 15126.6[f][3]). The analysis should focus on alternatives that are feasible (i.e., that may be accomplished in a successful manner within a reasonable period of time) and that take economic, environmental, social, and technological factors into account. Alternatives that are remote or speculative need not be discussed. Furthermore, the alternatives analyzed for a project should focus on reducing or avoiding significant environmental impacts associated with the project as proposed.

The State CEQA Guidelines (Section 15126.6[e]) require that, among other alternatives, a “no-project” alternative be evaluated in comparison to the project and that it “discuss the existing conditions, as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with the available infrastructure and community services.” Accordingly, a No Project Alternative is analyzed in this draft EIR (DEIR).

Descriptions of project alternatives are provided below. The advantages and disadvantages of each, compared to the project, are presented and an evaluation of each alternative’s ability to meet the project’s objective is included. Any significant environmental impacts created exclusively by an alternative are also identified. Finally, a summary of the impacts for each resource area, as compared to the project, is provided at the end of each discussion (i.e., less, greater, or similar).

A more detailed description of the baseline conditions, evaluation methodology, and results are included in Chapter 4 of this DEIR.

## 7.2 SUMMARY OF ENVIRONMENTAL IMPACTS

The purpose of this section is to summarize the specific environmental constraints, as identified and discussed in Chapter 4, “Affected Environment, Thresholds of Significance, Environmental Impacts, and Mitigation Measures,” of this DEIR. Potential environmental impacts, including indoor air quality (i.e. mold) and drinking water quality could result in significant or potentially significant environmental impacts. After implementation of the proposed mitigation measures, all of the impacts associated with the project would be reduced to less-than-significant levels. The potential for the alternatives to avoid or reduce the project’s significant impacts was considered in the analysis of alternatives.

As discussed in Section 4.1, “Air Quality,” the project could result in a potential significant increase in pipe failure and as a result of pipe failure, a resultant exposure of sensitive receptors to molds, which would be an indoor air quality impact. PEX tubing which has not been tested under NSF P171 CL-R in buildings with continuously recirculating hot chlorinated water systems within jurisdictions that use chlorine may have shorter product lives than copper, chlorinated polyvinyl chloride (CPVC), or PEX used in traditional domestic systems. However, proposed mitigation would require PEX to be tested using the NSF P171 CL-R standard or a comparable yet-to-be-adopted test which tests for continuously recirculating hot chlorinated water and incorporates a safety factor to account for unusually high chlorine levels or harsh water conditions. With implementation of recommended mitigation, this impact would be reduced to a less-than-significant level.

As discussed in Section 4.2, “Public Health and Hazards,” the project could result in a significant increase in pipe failure and as a result of pipe failure, exposure of sensitive receptors to molds. PEX tubing which has not been tested under NSF P171 CL-R in buildings with continuously recirculating hot chlorinated water systems within jurisdictions that use chlorine may have shorter product lives than copper, chlorinated polyvinyl chloride (CPVC), or PEX used in traditional domestic systems. However, proposed mitigation would require PEX to be tested using the NSF P171 CL-R standard or a comparable yet-to-be-adopted test which tests for continuously recirculating hot chlorinated water and incorporates a safety factor to account for unusually high chlorine levels or harsh water conditions. With implementation of recommended mitigation, this impact would be reduced to a less-than-significant level.

As discussed in Section 4.4, “Water Quality,” the project would increase the use of PEX tubing in California and testing indicates that a proportion of PEX tubing has been associated with the leaching of methyl tertiary butyl ether (MTBE) at levels exceeding the primary and secondary California maximum contaminant level (MCL), and tertiary butyl alcohol (TBA) at levels exceeding the California notification and response levels. In addition, PEX has the potential to leach Proposition 65 chemicals in concentrations higher than allowed under Proposition 65 and its implementing regulations. The California Building Standards Commission (BSC) will adopt mitigation to ensure that that any leached concentrations of MTBE, TBA, or Proposition 65 chemicals are below the relevant MCL, notification level, Proposition 65 Safe Harbor, or other applicable Proposition 65 level for those chemicals. With implementation of recommended mitigation, this impact would be reduced to a less-than-significant level.

Additionally, in cases where PEX is placed below the slab (i.e., underneath the house) where contaminated soils or water is present and is permeated by solvents or gasoline, PEX has the potential to introduce those chemicals into drinking water at levels in exceedence of federal and California MCLs, notification or response levels, or the Proposition 65 safe harbor or other applicable levels. However, BSC will adopt mitigation that prohibits the installation of PEX for potable water below the slab unless a Phase I Environmental Site Assessment in accordance with ASTM E1527-05 is conducted and concludes that site soils are not contaminated, or the PEX tubing is sleeved. With implementation of recommended mitigation, this impact would be reduced to a less-than-significant level.

Finally, the proposed project would result in the increased use of PEX tubing in California, 25.4% of which exceeds the secondary MCL for MTBE for taste and odor set by the California Department of Public Health. BSC will adopt a mitigation measure to ensure that that any leached concentrations of MTBE are below the secondary MCL for MTBE. With implementation of this mitigation, this impact would be reduced to a less-than-significant level.

## 7.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

State CEQA Guidelines Section 15126.6(c) provides that an EIR “should also identify any alternatives that were considered by the lead agency but rejected as infeasible during the scoping process and briefly explain the reasons underlying the lead agency’s determination.”

One alternative considered but rejected from consideration is an alternative that would have limited the use of PEX to highly acidic or highly alkaline soils because copper is known to corrode in highly alkaline or highly acidic soils, so perhaps PEX would be a better material to use in that case. However, restricting use to a certain type of soil would be infeasible to implement because it would require soil testing for each project.

Another alternative considered was to evaluate other types of plastics for plumbing uses in California. However, there are no new plastic piping materials that the BSC is aware of that are not already approved for use in California for which there is sufficient information for California to make an informed decision regarding its efficacy and safety at this time.

## 7.4 ALTERNATIVES CONSIDERED FOR DETAILED EVALUATION

The analysis presented below evaluates two alternatives to the project: No Project Alternative and a Mitigated Design Alternative. These alternatives were selected based on their ability to reduce or avoid the project's significant impacts based on the constraints identified in Section 7.2, "Summary of Environmental Impacts." Although the number of alternatives considered is relatively limited, given the nature of the project, adoption or not of specific plumbing regulations that would allow the use of PEX, the range of alternatives is reasonable. Because the basic objective of the project involves providing another plastic piping alternative for use in California, alternatives that are inconsistent with this objective are not considered. All the alternatives considered herein are designed to reduce the impacts of the project and provide a reasonable range of alternatives for consideration by decision makers.

### 7.4.1 ALTERNATIVE A: NO PROJECT ALTERNATIVE

The proposed project would adopt new state plumbing code regulations that would remove the prohibition against the statewide use of PEX tubing in various cold and hot water plumbing (including potable water) applications in residential, commercial, and institutional buildings. As discussed in Chapter 3, "Description of the Proposed Project," PEX is widely used throughout California for hydronic radiant heat flooring and is authorized for all uses in manufactured homes. Three cities have adopted ordinances allowing unrestricted PEX use and nearly 200 California cities and nearly 30 California counties have approved the use of PEX as an alternate material. The No Project Alternative is defined as the current pipe usage in California plus the reasonably foreseeable future pipe usage for approved plumbing materials if the regulation is not adopted and the prohibition against the use of PEX for hot and cold water distribution (including potable water uses) is not removed.

The 2005 California market shares for piping materials for new single-family homes were approximately 29% PEX, 13% CPVC, 54% copper, and 4% for all other materials. More recent data on PEX indicate that it now constitutes 37% of the California market for piping materials for new single-family homes. Assuming that the proposed regulation is not adopted, the market share for PEX could remain at about 37% for new single-family homes. The November 2006 recirculated DEIR for the Adoption of Regulations Permitting the Statewide Residential Use of CPVC (HCD 2006:45) projected that with the adoption of that regulation, the market share for CPVC for new single-family homes would increase to approximately 30%, which is equal to the percent of the nationwide market share for CPVC. Therefore, a likely distribution of market share in California for new single-family homes under a No Project scenario could eventually comprise approximately 30% CPVC, 37% PEX, 29% copper, and 4% all other materials.

With or without the proposed project, it is anticipated that the market share for copper in California will continue to decline and the proportion of plastic pipe use will continue to grow proportionately. This is due in part to recent changes to federal drinking water standards to reduce exposures to disinfection by-products (dbps), specifically trihalomethanes, which are known carcinogens and reproductive toxicants. The most economical way for public water agencies to meet the new federal standards to reduce exposure to dbps is to switch from chlorine to chloramines for disinfection of water supplies (EPA 2007a). That switch has been a recent trend in California

(EPA 2007b). As discussed in Section 4.2, “Public Health and Hazards,” and Section 4.4, “Water Quality,” chloramines have a corrosive effect on copper tubing. This fact, combined with the lower costs for materials and labor related to the use of plastic piping materials, means that it is likely that the plastic tubing market in California will continue to grow, even under the No Project Alternative. If use of PEX in California were to decline under the No Project Alternative, it is likely that the result would be an increase in the use of CPVC rather than an increase in the use of copper for the reasons discussed above.

Consistent with CEQA requirements, this No Project Alternative is evaluated in this DEIR. The No Project Alternative would not meet the project’s basic objective to provide an alternative hot and cold water plumbing material for use in California, but it allows decision makers and the public a way to compare the impacts of approving the proposed project with the impacts of not approving the proposed project.

## ENVIRONMENTAL ANALYSIS

### Air Quality

The No Project Alternative would involve the continued use of copper, CPVC, and other plastic tubing in California, in a market historically dominated by copper. The production process of copper is environmentally intensive. Copper ore is strip-mined, shipped, and smelted during its life cycle (Mitchem, pers. comm., 2007). Under the No Project Alternative, the generation of toxic air contaminant (TAC) emissions and related exposure associated with production and manufacture of copper tubing would not result in any change relative to existing conditions.

In the short term, installation and repair of copper tubing, the dominant material in water tubing use in California, requires soldering, which releases toxic and carcinogenic smoke and vapors into the atmosphere. A study measuring organic vapors generated during soldering of copper tubing demonstrated that the vapors contain the following chemicals, known to be present on the California Air Resources Board’s (ARB’s) TAC Identification List: chlormethane; vinyl chloride; chloroethane; carbon disulfide; isopropyl alcohol; methlyene chloride; hexane; vinyl acetate; 2-butanone; benzene; 1,2 dichlorethane; trichloroethylene; 1,4-dioxane; toluene; 4-methyl-2-pentanone; tetrachlorethylene; ethyl benzene; chlorobenzene; m/p-xylene; o-xylene; styrene; and benzyl chloride (ARB 2008, HCD 2006). Though the amount of these chemicals emitted into the atmosphere during the copper soldering process was not quantified in this study, it provides a basis for the potential air quality effects from copper tubing installation under existing conditions (Research Triangle Park Laboratories 2006, as cited in HCD 2006:34–35). See Section 4.2, “Public Health and Hazards,” for an analysis of worker exposure to solder emissions associated with installation of copper tubing. The generation of TAC emissions and related exposure associated with installation of copper would not result in any change relative to existing conditions.

In addition, as described above under the No Project Alternative, the market for allowable plumbing materials in California would continue to trend toward plastic tubing, and CPVC is the only plastic tubing currently approved for statewide potable water uses. Installation of CPVC requires the use of adhesives and solvents that emit volatile organic compounds into the atmosphere, including reactive organic gases (ROG), which are precursors to the criteria air pollutant, ozone. As analyzed in the DEIR prepared for CPVC, allowing the expanded use of CPVC in California would result in a significant and unavoidable impact with respect to emissions of ROGs in several California Air Districts (HCD 2006:49–50). Under the No Project Alternative, the market would continue to trend further toward the use of CPVC in California, thus, further increasing ROG emissions associated with adhesives and solvents used in installation of CPVC, and increasing the severity of this already significant and unavoidable impact (i.e., increased emissions of criteria air pollutants or precursors). This would be a significant impact of the No Project Alternative.

Because this alternative would increase ROG emissions associated with adhesives and solvents used in the installation of CPVC, increasing the severity of this significant and unavoidable impact, this alternative would result in **greater** air quality impacts than the proposed project.

### Public Health and Hazards

Under the No Project Alternative, increased risk of *Legionella* growth would be similar to the project because all piping materials exhibit some amount of biofilm formation, and no direct quantitative correlation exists between measurements of biofilm and growth of *Legionella* (Veenendaal and van der Kooij 1999). Therefore, increased biofilm growth does not correspond to higher amounts of *Legionella* bacteria, and the use of CPVC and PEX tubing in California would not lead to increased risk of human contact with pathogenic bacteria. This is a less-than-significant impact, and is this alternative would result in **similar** biofilm impacts as the project.

Copper tubing requires an open flame for welding pieces together, and this may pose a fire threat if safety precautions are not implemented. However, because welders using copper tubing are required to comply with industry safety regulations, the threat of increased fire hazard during welding of copper tubing is very unlikely. Copper also has a very high melting point, 1,984.3°F (Environmental Chemistry 2008), which is much hotter than the average structural fire. The continued use of copper tubing is unlikely to result in increased fire hazards.

CPVC was recently approved for use in California on January 1, 2008, and therefore, data pertaining specifically to how CPVC reacts in fires is not readily available. However, CPVC pipes have similar characteristics to other plastic pipes. Therefore, the discussion in Impact 4.2-2, for the proposed project, applies to CPVC pipes. The use of plastic pipes, including CPVC, is not likely to increase fire ignition and fire spread. The use of copper and CPVC would not result in increased fire hazard. Therefore, this impact is less than significant, and fire spread impacts would be **similar** to the proposed project.

Since the introduction of chloramines to disinfect the potable water supply in place of chlorine, in some areas copper tubing has failed because of corrosion from the use of chloramines. Additionally, jurisdictions with "aggressive" (i.e., corrosive) water may experience copper tubing failure because of the corrosive nature that is characteristic of this type of water. While copper tubing failure does occur, this problem is confined to certain areas within California where chloramines are used and where aggressive water is a problem. Therefore, copper tubing failure is not representative of the historical and statewide use of copper tubing. Further, the current and projected use of CPVC, PEX (in some jurisdictions), and other materials for potable water plumbing provide viable alternatives for the specific parts of California where chloramines and aggressive soils cause copper tubing failure. Because the No Project Alternative provides for plumbing material that will not result in pipe failure, it would not result in a significant mold impact, and this alternative's mold impacts are considered **less** than those associated with the proposed project.

Copper tubing is currently used for the majority of potable water pipes installed in California. The recirculated DEIR for CPVC (CPVC RDEIR) (HCD 2006) assessed worker safety issues for the installation of copper tubing (HCD 2006:134–139). Installing copper requires the application of flux (a substance used to promote fusion, such as rosin) and the use of a propane torch to join pipe pieces together. The application of flux presents danger to workers if not done correctly because of the corrosive nature of flux and potentially harmful fumes. The CPVC RDEIR cites studies that concluded that numerous toxic organic vapors are generated during the copper tubing soldering process. These materials are released into the workplace atmosphere and can be inhaled by workers if safety precautions are not implemented. Additionally, heat sources generated and used during soldering can cause serious burns and start fires. Copper tubing also poses a risk of electrocution because it conducts electricity very well. Health risks associated with copper tubing installation would not be expected to occur to installers who comply with recommended installation and safety practices (HCD 2006:134–139). Because there are industry standards regarding health and safety issues for workers, this is considered a less-than-significant impact.

CPVC was approved for statewide use beginning January 1, 2008. Existing law and regulations require that employers provide the safety equipment recommended in label directions and safe use instruction on the Materials Safety Data Sheet. Compliance with label directions and safe use instruction is enforced by the California Occupational Safety and Health Administration, and a failure to comply could result in penalties. The CPVC RDEIR cites worker safety studies from the National Institute for Occupational Safety and Health, the California

Department of Health Services, Robert G. Tardiff, and Thomas Reid. Both short-term and long-term exposure was assessed. This RDEIR concluded that inhalation exposure to vapors from CPVC installation, dermal exposure to CPVC adhesives, and carcinogenic effects from CPVC adhesives, were all less-than-significant worker safety impacts (HCD 2006:142–152). Because the impact under the proposed project is beneficial, while under the No Project Alternative it is less than significant, this alternative would result in **greater** safety impacts than the proposed project

PEX can be as durable as or even more durable than other currently approved plumbing materials, however it is prone to oxidation under certain conditions. The NSF and ASTM testing standards generally provide adequate assurances that PEX will last for the duration that it is certified to last (generally at least 40–50 years). However, ASTM does not currently test for continuously recirculating chlorinated hot water and this fact creates the possibility of a potentially significant mold impact if PEX should fail under certain circumstances. It is not that PEX certified under ASTM 2023 would necessarily fail in a continuously recirculating system, rather, it is that NSF 171 CL-R is the only currently used standard that considers chorine resistance under this particular use of PEX. Because the No Project Alternative provides for plumbing materials that would not result in a significant mold impact, this alternative would avoid the project's potentially significant mold-related impact, and this alternative would result in **less** mold impacts than the proposed project. However, after mitigation, the impacts of the proposed project would be reduced to less-than-significant levels. In summary, the proposed project would result in potentially significant mold-related impacts, and these impacts would be reduced to less-than-significant levels after mitigation.

Because the No Project Alternative provides for plumbing materials that would not result in a significant mold impact, this alternative would avoid the project's potentially significant mold-related impact, and mold impacts under this alternative would be less than the proposed project. Overall, the No Project Alternative would result in **less** public health and hazards impacts than the proposed project.

### Solid Waste

Under the No Project Alternative, the use of PEX would be expected to remain at current levels or perhaps decrease slightly while the use of CPVC would be expected to increase from about 14% of the market share for new single-family homes to about 30% (HCD 2006). The use of copper is projected to decrease under all of the alternatives. However, this reduction may be slightly less under the No Project Alternative because fewer tubing choices would be available in many jurisdictions.

CPVC plastic pipe was recently approved for statewide potable water uses including residential buildings beginning January 1, 2008. Similar to the proposed PEX tubing project, the approval of CPVC for statewide potable water use is expected to increase the volume of plastic tubing debris requiring disposal. Plastic tubing debris would be generated when CPVC and PEX tubing is replaced in an existing structure, when CPVC and PEX tubing is installed in a new structure, and when various types of buildings and structures containing PEX and CPVC tubing are demolished. Assuming plastic pipes and fittings represent 100% of all durable plastic items in the construction and demolition waste stream, and PEX and CPVC tubing represent 100% of all plastic pipes and fittings, PEX and CPVC tubing would represent up to 0.04% of the waste placed in landfills annually. Although PEX is not currently recyclable, some amount of PEX tubing could be diverted and sold for other uses such as composite lumber, irrigation tubing, or filler in cement and asphalt. CPVC is recyclable, and it would be reasonable to assume that some CPVC would be diverted in the future. In addition, future new technologies, markets, or policies could possibly emerge resulting in the diversion of additional PEX and CPVC from landfills. Therefore, the maximum amount of PEX and CPVC solid waste generated annually under the No Project Alternative would not be substantial in relation to the total amount of landfilled solid waste, and would not affect the ability of any landfill to accept the waste or result in early closure of any landfill. The volume of solid waste generated under the No Project Alternative may be slightly less than the amount of solid waste generated under the proposed project if the decline in copper use is reduced because of fewer alternative tubing materials available in some jurisdictions. Therefore, the potential solid waste impact of the No Project Alternative is less than significant.

Because the proposed project would not result in any significant impacts related to solid waste and the No Project Alternative would not reduce or avoid any significant impacts related to this issue area, **similar** impacts would occur.

## Water Quality

### *Noncompliance with Drinking Water Standards Resulting from Leaching*

PEX tubing is tested by NSF International to determine whether compounds that may leach from PEX are found at concentrations greater than the NSF reference criteria (which are derived from U.S. Environmental Protection Ageny (EPA) and Health Canada drinking water standards and NSF-derived risk-based levels). For some compounds, California has adopted Public Health Goals (PHGs), or PHGs, MCLs, notification levels, Proposition 65 Safe Harbor levels, and secondary MCLs based on taste and odor considerations (which are not considered in the NSF protocol), that are more stringent than the standards used by NSF. Therefore, it is possible that some compounds could leach from PEX in concentrations that exceed California drinking water criteria, even though they may comply with EPA criteria or other criteria used by NSF. Under the No Project Alternative, the use of PEX would remain the same as under current conditions or possibly decline slightly. The proposed project would increase the use of PEX tubing, and testing indicates that a proportion of PEX tubing has been associated with leaching levels of MTBE at levels exceeding California MCLs for MTBE and exceeding the California notification and response levels for TBA. In addition, PEX has the potential to leach Proposition 65 chemicals in concentrations higher than allowed under the Proposition 65 statute and implementing regulations. Proposed project impacts would be reduced to less-than-significant levels after mitigation. Because the use of PEX under the No Project alternative would remain the same as under current conditions, and PEX use would increase under the proposed project, the No Project Alternative would avoid the proposed project's leaching impacts, and impacts would be **less** under this alternative.

### *Noncompliance with Drinking Water Standards Resulting from Permeation*

In cases where PEX is placed below the slab where contaminated soils are present and permeated by solvents or gasoline, PEX has the potential to introduce chemicals into drinking water at levels that exceed federal and California MCLs, notification and response levels, or Proposition 65 Safe Harbor levels, which could result in a potentially significant impact. The proposed project would increase the use of PEX tubing. Proposed project impacts would be reduced to less-than-significant levels after mitigation. Because the use of PEX under this alternative would remain the same as under current conditions, and PEX use would increase under the proposed project, this alternative would avoid proposed project permeation impacts, and impacts would be **less** under this alternative. Noncompliance with California MCL for Copper in Drinking Water or TMDL for Copper in a Surface Water Body

In situations where the pH of water is below 6.5, the potential exists for copper to leach from copper tubing into drinking water at concentrations above allowable levels (NSF International 2004). It is not unusual for drinking water to become slightly acidic (i.e., pH less than 7.0) because dissolution of naturally occurring carbon dioxide ($CO_2$) or nitrogen dioxide ($NO_2$) from the atmosphere into surface water can cause water to take on acidic properties (carbonic acid, nitric acid, respectively). Treatment processes, such as reverse osmosis and ozone, which are commonly used in California, are also known to lower the pH of water.

One effect of the federal disinfection by-products rules has been a trend of public water systems toward using chloramines in favor of chlorine for drinking water disinfection. According to EPA, because chloramines are not as reactive as chlorine, it forms fewer disinfection by-products. Because residual from chloramines is more stable and longer lasting than free chlorine, it provides better protection against bacterial regrowth in systems with large storage tanks and dead-end water mains. (EPA 2007a.) Chloramines, like chlorine, are effective in controlling biofilm, which is a coating in the pipe caused by bacteria. Controlling biofilm also tends to reduce coliform bacteria concentrations and biofilm-induced corrosion of pipes. Because chloramines do not tend to react with organic compounds, many systems will experience fewer taste and odor complaints when using chloramines. Chloramine technology is relatively easy to install and operate. It is also among the less-expensive disinfectant alternatives to chlorine.

Use of chloramines can result in potential water quality problems (e.g., nitrification and corrosion) if the treatment process is not carefully controlled and the system's operational practices are not appropriately adjusted for the new disinfectant. Chloramines can change the chemical properties of the water, which can corrode lead and copper. Chloramines can indirectly affect corrosion of lead and copper in two ways. First, when chloramines are used in water treatment as a residual disinfectant, it can change the chemical properties of the water, which subsequently can corrode lead and copper. Certain conditions related to pH, alkalinity, and dissolved inorganic carbonate levels in the water can cause lead to dissolve from pipe material. Second, chloramination, if not properly optimized, can result in nitrification (conversion of ammonia into nitrite and then nitrate) in the presence of bacteria. Nitrification can lower the pH of the water, which can increase corrosion of lead and copper. EPA makes the following recommendations to reduce the increased risk of corrosion as a result of the switch to chloramines:

- The water system should perform an optimal corrosion control treatment study before introducing chloramines into the distribution system.

- The water system should add chemicals to the finished water to form a protective coating on the pipes, such as an orthophosphate corrosion inhibitor.

- The water system should optimize the chloramination process to minimize the possibility of nitrification that can reduce pH and increase corrosion.

The No Project Alternative would not likely increase the use of copper above current levels and thus would result in a less-than-significant impact regarding copper in drinking water. Compared to current levels, copper use would likely decrease under the proposed project. Because copper use under the No Project Alternative would be higher than copper use under the proposed project, this alternative would result in **greater** copper-related impacts.

### *Exposure of Sensitive Receptors to Odors*

The No Project Alternative would involve the continued use of copper, CPVC, and other plastic pipe in California, in a market historically dominated by copper. In situations where the pH of water is below 6.5, there is the potential for copper to leach from copper tubing into drinking water in concentrations above allowable levels (NSF International 2004). This situation is not uncommon; drinking water can become slightly acidic (i.e., pH less than 7.0) from dissolution of $CO_2$ or $NO_2$ into surface water from the atmosphere, which can cause water to take on acidic properties (carbonic acid, nitric acid, respectively), and treatment processes commonly used in California are also known to lower the pH of water.

Chemicals found to leach from currently allowed pipe materials, the applicable secondary MCLs, and perceived taste and odor of the drinking water are summarized in Table 7-1.

Under existing conditions, taste and odor of drinking water are affected by dissolved chemicals and may cause associated taste and odor impacts for some individuals. The No Project Alternative would not result in a change from existing conditions and because no substantial adverse condition is known to exist, the impact would be considered less than significant. The proposed project would result in the increased use of PEX tubing in California, 25.4% of which exceeds the secondary MCL for MTBE for taste and odor set by DPH, and this would be a significant impact. Because the No Project alternative would not result in a change from existing conditions, and would avoid the taste and odor impacts associated with MTBE, impacts would be **less** under this alternative.

| Table 7-1<br>Potential Chemicals Present in Drinking Water Transported through Allowable Materials under No Project Alternative and Secondary Maximum Contaminant Level Standards | | | |
|---|---|---|---|
| Substance | NSF Standard for Copper or CPVC | Secondary MCL | Perceived Taste or Odor and Threshold |
| copper | - | 1 ppm[1] | metallic |
| antimony | - | - | metallic/5 ppb |
| m-chlorophenol | - | - | phenolic (sour or bitter)/ 5 ppb |
| cyclohexanone | - | - | acetone/0.12 ppm |

Notes:
CPVC = chlorinated polyvinyl chloride; MCL = maximum contaminant levels; ppb = parts per billion; ppm = parts per million
[1] California Secondary MCL is more stringent than ANSI/NSF Standard 61, which provides information to water utilities on potential taste and odor concerns from materials used in contact with drinking water.
Source: Title 22, California Code of Regulations, Section 64448, Tomboulian et al. 2004

Overall, the No Project alternative would avoid potentially significant and significant project-related water quality impacts, and water quality impacts would be **less** under this alternative.

### CONCLUSION

The No Project Alternative would be environmentally superior to the project with respect to public health and hazards, leaching of chemical compounds into drinking water and indoor air quality (i.e., mold). It would be similar to the project with respect to solid waste, and would result in greater environmental impacts to outdoor air quality (ROGs) and leaching of copper into drinking water and wastewater. Overall, the No Project Alternative is environmentally superior to the proposed project. This alternative would not attain the project's objective of providing an alternative plastic hot and cold water plumbing material for use in California.

## 7.4.2 ALTERNATIVE B: MITIGATED ALTERNATIVE

Alternative B would provide another plastic hot and cold water plumbing material for use in California. Under Alternative B, all PEX used in California for human consumption purposes would be certified by NSF to meet the relevant primary and secondary MCL, notification, Proposition 65 Safe Harbor, or other applicable Proposition 65 levels for drinking water. Alternative B would also require that PEX only be used above the slab unless a Phase 1 Environmental Site Assessment for the project is conducted following the ASTM E 1527-05 standard, which concludes that contamination of the soils or groundwater in the project area is unlikely, or unless the PEX is sleeved by a metal pipe or other proven impermeable barrier. Finally, for all continuously recirculating hot water systems in jurisdictions where chlorination is used for disinfection of water, PEX tubing must be certified using the NSF P171-CL-R standard or a yet-to-be-adopted comparable standard.

### ENVIRONMENTAL ANALYSIS

### Air Quality

Because installation and repair of PEX tubing would not require the use of adhesives or solvents (i.e., ROGs) or require soldering (which is a source of respirable particulate matter [$PM_{10}$]), it would not increase emissions of ozone precursors (e.g., ROGs and oxides of nitrogen), lead, sulfur oxides, carbon monoxide, or PM. Thus, this discussion does not focus on the project's potential to increase emissions of criteria air pollutants or precursors, and these pollutants will not be discussed further. The exposure of sensitive receptors to TAC emissions from the production of PEX and construction-related activities is discussed separately below.

PEX tubing is not currently produced in the State of California. It is also not produced in the States of Washington, Oregon, Nevada, Arizona, or in Baja, Mexico (Taber, pers comm., 2008). Industrial facilities, such as chemical plants and manufacturing plants where PEX is currently produced in the United States are required by federal measures to reduce emissions and to obtain air pollution permits to ensure compliance with the federal Clean Air Act (CAA) (EPA 2008). Although the proposed project may increase demand for PEX tubing and could result in the need to increase PEX production, air pollutant emissions from the facilities at which PEX is produced are regulated. Compliance with the federal CAA and state and local permit processes can reasonably be expected to maintain emissions from PEX manufacturing facilities within acceptable limits. Thus, Alternative B would not result in exposure of sensitive receptors in California to excessive pollutant concentrations. Alternative B would not result in an increase in stationary-source emissions in California. Any potential increase in stationary-source emissions in another state would be controlled by the EPA and would be subject to EPA and local permitting processes. Thus, this impact would be less than significant and is **similar** to the proposed project.

Construction activities associated with PEX installation would not require any change from business as usual. Specifically, the proposed project would not result in an increased construction work force or labor hours needed to install pipe, nor would the proposed project result in greater quantities of on-site construction equipment. Moreover, given the light weight of PEX as opposed to copper, less fuel would be required to truck the tubing to the construction site and may result in a reduction of $PM_{10}$ and other trucking-related emissions. Emissions of air pollutants attributable to construction worker commute and construction equipment exhaust would not differ from existing conditions. To the extent that PEX would be used in place of copper tubing, this would eliminate the TAC and $PM_{10}$ emissions associated with the soldering process during installation. This impact would be beneficial and is **similar** to the proposed project.

As discussed in Impact 4.2-3 (see Section 4.2, “Public Health and Hazards”), chlorinated potable water could cause PEX that is used in continuously recirculating hot water systems to prematurely fail if it is not certified under the NSF P171 CL-R standard or a yet-to-be-adopted comparable standard, described more fully in section 4.2. Premature failure of PEX tubing could lead to moisture buildup in structures. If the failure goes unnoticed for an extended period of time in a poorly ventilated area of the structure, the potential exists for biological agents to grow and spread. Biological agents including bacteria, viruses, fungi (e.g., molds) can cause allergic reactions; asthma; eye, nose, and throat irritation; and humidifier fever, influenza, and other infectious diseases (ARB 2003). Because PEX tubing could prematurely fail and could lead to moisture buildup in structures, exposing sensitive receptors to mold, this impact is potentially significant. However, because Alternative B requires certification under the NSF P171 CL-R standard or a yet-to-be-adopted equally rigorous standard, this potential mold impact is reduced to less-than-significant and impacts would be **less** than the proposed project.

Overall, because air quality impacts under Alternative B are less than or similar to the proposed project, air quality impacts would be **less** under this alternative.

## Public Health and Hazards

Because biofilm could potentially harbor pathogenic bacteria such as *Legionella*, there is concern that higher amounts of biofilm could potentially lead to increased risk of human contact with pathogenic bacteria. All piping materials exhibit some biofilm formation (Chaudhuri, pers. comm., 2008). Although formation of biofilm is initially slower in copper tubing compared to PEX tubing, no substantial difference exists over longer periods. No direct quantitative correlation exists between measurements of biofilm and growth of *Legionell*a. Therefore, increased biofilm growth does not correspond to higher amounts of *Legionella* bacteria, and the use of PEX would not lead to increased risk of human contact with pathogenic bacteria. Therefore, this is considered a less-than-significant impact of Alternative B and is **similar** to the proposed project.

Comments have been made that when filled with water, PEX is not likely to be flammable, but when exposed to heat during a fire, the PEX may rapidly rupture. PEX rupture may drain or depressurize the plumbing system and create openings in wall studs that may encourage the spread of fire (Coalition for Safe Building Materials

2005:44). Concerns exist that the use of PEX tubing poses a significant fire threat because of the highly flammable characteristics of PEX (Coalition for Safe Building Materials 2005:44). Please see discussion under Impact 4.2-2 in Section 4.2 for a detailed discussion of this issue. PEX tubing carrying water within a building is not likely to be flammable because plastic is not particularly flammable generally and when full of water flammability is further reduced. Conformance to CPC requirements and applicable design and installation guidelines, including the use of approved firestop material, would reduce any potential fire hazards related depressurization of plastic tubing during structural fires. Additionally, plastic tubing is not an efficient heat conductor and structural fires generally do not exceed the temperature necessary to cause plastic tubing to catch on fire, so the use of PEX would not increase fire hazards. Because PEX meets the firestop standards specified in the California Administrative Code, Section 1501.1 et seq., PEX does not increase fire hazards or encourage fire spread. Therefore, this impact is considered less than significant and is **similar** to the proposed project.

### *Risk of Premature or Unexpected PEX Failure Potentially Increasing the Incidence of Mold*

UV light, certain firestop materials, and chlorine can contribute to failure of PEX. However, PEX manufacturers add UV resistant material into the pipe and include instructions to avoid UV degradation, which decreases the impact of UV light on PEX. Numerous firestop materials are compatible with PEX and as long as those are used, firestop materials do not degrade PEX. Finally, the possibility of PEX failure from chlorine degradation would be confined to jurisdictions that have not yet switched to chloramine disinfection and specifically to projects in those jurisdictions that use continuously recirculating, hot, chlorinated water systems. Without attack from chloramines or aggressive water or soils, copper tubing is known to outlast the buildings in which they are installed. However, no data shows the actual life expectancy of CPVC and PEX; there is only data from the NSF and ASTM testing methods which is based on extrapolation. Because the ASTM standard does not consider systems with continuously recirculating hot chlorinated water or incorporate a design factor, while the NSF test does, the level of certainty provided by ASTM F2023 is not as great as that provided by NSF P171. Because PEX tubing within jurisdictions that use chlorine and continuously recirculating hot chlorinated water systems may have shorter product lives that copper, CPVC or PEX in traditional domestic applications, this is considered a potentially significant impact.

As discussed in Impact 4.2-3 (see Section 4.2, “Public Health and Hazards”), chlorinated potable water in continuously recirculating systems could cause PEX that is not certified to the NSF 171-CL-R standard to prematurely fail, though this is not certain. Please see Impact 4.2-3 for a complete discussion of this issue. Premature failure of PEX tubing could lead to moisture buildup in structures. If the failure goes unnoticed for an extended period of time in a poorly ventilated area of the structure, the potential exists for biological agents to grow and spread. Biological agents including bacteria, viruses, fungi (e.g., molds) can cause allergic reactions; asthma; eye, nose, and throat irritation; and humidifier fever, influenza, and other infectious diseases (ARB 2003). Because Alternative B would require that PEX used in continously recirculating systems in jurisdictions that use chlorination to disinfect water supplies be certified under the NSF-P171-CL-R standard or a yet-to-be adopted equally rigorous standard that assumes 100% continuously recirculating chlorinated hot water, would ensure a conservative product lifetime of 40 years and is approved by the Building Standards Commission for testing PEX for continuously recirculating hot chlorinated water, this potential impact is less-than-significant and may be **less** than the proposed project.

Overall, because public health and hazards impacts under Alternative B are less than or similar to the proposed project, public health and hazards impacts would be **less** under this alternative.

## Solid Waste

PEX tubing is currently approved for statewide use in California hydronic radiant heating systems and all manufactured home uses. Nearly 200 cities and 30 counties in the state have approved PEX tubing for hot and cold water (including potable water) applications in residential, commercial, and institutional buildings using alternate materials provisions (see Chapter 3, “Description of the Proposed Project”). Implementation of the proposed project would increase the use of PEX tubing for potable water applications, with a proportionate decrease in the use of other piping materials (such as copper). It is assumed that Alternative B would increase the estimated percentage use of PEX tubing in California from approximately 37% to 45% because of the reduced labor costs associated with installation of PEX and because of corrosivity issues with copper piping resulting from the increased use of chloramines for drinking water disinfection (see Section 3.4.4, “Current and Projected Uses of PEX”). Alternative B implementation would also change the estimated percentage use of other types of plastic pipe.

Although Alternative B would slightly increase the amount of scrap PEX generated for disposal (i.e., a maximum of 0.03% of the total annual solid waste sent to landfills statewide), the maximum amount of solid waste annually generated by proposed project implementation is not substantial in relation to the total amount of landfilled solid waste (i.e., 40,235,328 tons). (Please see Section 4. 3, “Solid Waste,” for an in-depth discussion of the potential solid waste impacts of PEX.) In addition, PEX tubing could be diverted and sold for other uses, and new recycling technologies, markets, or policies could emerge. Furthermore, beyond speculation, it is difficult to estimate exactly where or when PEX tubing would be disposed and what the capacity of various existing and future landfills throughout the state will be at the time of disposal, exactly to what extent it will be reused or recycled, or what the plastics disposal laws will be at that time. In any case, there is no substantial evidence that the addition of PEX waste, in and of itself, would be sufficient to substantially consume landfill capacity or otherwise shorten the planned disposal life of any landfill. Therefore, this impact is considered less than significant, and is **similar** to the proposed project.

The California Integrated Waste Management Act (CIWMA) requires cities and counties to reduce their solid waste stream by 50% by “through source reduction, recycling, and composting activities” (Section 41780). This requires cities and counties to divert a substantial portion of the waste stream that would otherwise go to landfills by a variety of means. From 1989 to 2004, the estimated annual statewide diversion rate increased steadily from 10% to 48%, and in August 2006, the California Integrated Waste Management Board (CIWMB) announced that the state had met the legislatively imposed 50% waste diversion rate. In 2005, California achieved a 52% waste diversion rate, and increased the diversion rate to 54% in 2006 (CIWMB 2008). Exhibit 4.3-1 illustrates these trends. Assuming these trends continue into the future, California will continue to meet the 50% waste diversion requirement as required by the CIWMA.

Although implementation of Alternative B would be expected to slightly increase the amount of solid waste going to statewide landfills, the maximum amount of solid waste generated annually by the proposed project is not substantial in relation to the total amount of landfilled solid waste. In addition, PEX diversion will likely increase in the future as PEX producers continue to establish markets for composite lumber and cement and asphalt filler, and new recycling technologies or policies emerge. Because the State of California is currently meeting the CIWMA diversion rate goal, the statewide diversion rate trend is on an upward trajectory, PEX diversion will likely increase in the future, and implementation of the proposed project would not indirectly violate or cause noncompliance with the CIWMA, this impact is considered less than significant and is **similar** to the proposed project.

Overall, because solid waste impacts under Alternative B are similar to the proposed project, solid waste impacts would be **similar** under this alternative.

### Water Quality

PEX tubing has been associated with the leaching of levels of MTBE and TBA at levels exceeding the California MCL and the California notification level, respectively. This would represent a potentially significant impact. In addition, PEX has the potential to leach Proposition 65 chemicals in concentrations higher than allowed under Proposition 65 and its implementing regulations, and this would also represent a potentially significant impact. However, Alternative B would require certification by NSF that PEX used in California meets the relevant primary and secondary MCL, notification, Proposition 65 Safe Harbor, or other applicable Proposition 65 levels for water for human consumption. Therefore, this impact would be less-than-significant, and impacts under this alternative would be **less** than the proposed project.

In cases where PEX is placed below the slab where contaminated soil or water is present and is permeated by solvents or gasoline, it has the potential to introduce chemicals into drinking water at levels in exceedance of federal and state MCLs. Because Alternative B would restrict the use of PEX for hot and cold water distribution including potable water uses to uses above the slab (i.e. above the foundation) unless a Phase 1 Environmental Site Assessment is conducted and concludes that site soils are not likely contaminated, or unless the PEX is sleeved by metal pipe or another form of pipe which has been proven to be impermeable and has been accepted by the BSC as an impermeable sleeving material, this impact would be less-than-significant, and **less** than under the proposed project.

The proposed project could also result in the leaching of chemicals into drinking water that affect taste and odor. Quantitative evidence is available in the record demonstrating that PEX is known to leach MTBE in concentrations that would exceed the secondary MCL for MTBE. However, there is no other chemical for which there is quantitative evidence of exceedance of a secondary MCL. Under Alternative B, PEX must be certified to meet California's secondary MCLs. Therefore, this potential impact would be less than significant, and impacts under this alternative would be **less** than under the unmitigated proposed project.

Overall, because water quality impacts under Alternative B are less than proposed project impacts, water quality impacts would be **less** under this alternative.

### CONCLUSION

Alternative B would be environmentally superior to the project with respect to public health and hazards, water quality and air quality. It would be similar to the project with respect to solid waste. Overall, this alternative is environmentally superior to the proposed project. The overall objective of the proposed project is to provide another plastic piping alternative for use in California. Alternative B would authorize the use of an additional type of plastic pipe in California, and thus would attain the project objective.

## 7.5 ENVIRONMENTALLY SUPERIOR ALTERNATIVE

The No Project Alternative would be environmentally superior to the project with respect to public health and hazards, leaching of chemical compounds into drinking water and indoor air quality. It would be similar to the project with respect to solid waste, and would result in greater environmental impacts in outdoor air quality (ROGs) and leaching of copper into drinking water and wastewater. Overall, this alternative is environmentally superior to the proposed project. This alternative would not attain the project's objective of providing an alternative plastic hot and cold water plumbing material for use in California.

Alternative B would be environmentally superior to the project with respect to public health and hazards, water quality and air quality. It would be similar to the project with respect to solid waste. Overall, this alternative is environmentally superior to the proposed project. The overall objective of the proposed project is to provide another plastic piping alternative for use in California. Alternative B would authorize the use of an additional type of plastic pipe in California, and thus would attain the project objective.

Alternative B: Mitigated Alternative is the overall environmentally superior alternative of all the alternatives evaluated.

# 8 PREPARERS OF THE ENVIRONMENTAL DOCUMENT

## 8.1 LEAD AGENCY

**California Building Standards Commission**

David Walls ........................................................ Executive Director

**California Department of General Services, Real Estate Services Division**

Robert Sleppy ........................................................ Environmental Services Section Chief
Valerie Namba ........................................................ Senior Environmental Planner

## 8.2 EIR CONSULTANTS

### PRIME CONSULTANT

**EDAW**

Sydney Coatsworth, AICP ........................................................ Project Director/Principal-in-Charge
Heather Halsey ........................................................ Senior Project Manager
Jason Barrett ........................................................ Assistant Project Manager/Analyst
Nisha Chauhan ........................................................ Environmental Planner
Honey Walters ........................................................ Senior Air Quality Specialist
Heather Phillips ........................................................ Air Quality Specialist
Mike Avina ........................................................ Planner
Christy Seifert ........................................................ Editor
Nancy Ray ........................................................ Administrative Support Specialist
Deborah Jew ........................................................ Word Processor
Amber Martin ........................................................ Word Processor
Roni Olaizola ........................................................ Word Processor
Brian Perry ........................................................ Graphics
Lorrie Jo Williams ........................................................ Graphics

### SUB CONSULTANTS

**Remy, Thomas, Moose and Manley LLP**

Whitman Manley ........................................................ CEQA Regulatory Specialist

**ENSR**

Ishrat Chaudhuri, Ph.D., DABT ........................................................ Senior Toxicologist

**Austin AECOM**

John Lohnes ........................................................ Vice President
Michael Bland, P.E. ........................................................ Mechanical Engineer

**Pacific Plumbing**

Mark Thielen ........................................................ Principal/Plumbing Expert

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# APPENDIX A

Notice of Preparation

**BUILDING STANDARDS COMMISSION**
2525 Natomas Park Drive, Suite 130
Sacramento, California 95833
(916) 263-0916 FAX (916) 263-0959

# Adoption of Statewide Regulations Allowing the Use of PEX Tubing

## Notice of Preparation

Prepared for the Lead Agency:

California Building Standards Commission

2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833

Contact: Valerie Namba, Senior Environmental Planner

Phone: (916) 376-1607

E-mail: valerie.namba@dgs.ca.gov

Prepared with the assistance of:

EDAW Inc.

2022 J Street

Sacramento, California 95811

Contact: Heather Halsey

Date: October 31, 2007[1]

To: Responsible Agencies, Interested Parties, and Organizations

Subject: Notice of Preparation and Initial Study

Lead Agency: The California Building Standards Commission

Contact: Ms. Valerie Namba, Senior Environmental Planner
California Department of General Services, Real Estate Services Division
Professional Services Branch, Environmental Services Division
707 Third Street, Suite 3-400
West Sacramento, CA 95605
Telephone: (916) 376-1607
Email: valerie.namba@dgs.ca.gov

**Purpose of Notice**

The California Building Standards Commission will be the lead agency for preparation of an environmental impact report (EIR) for statewide regulations that would allow the use of cross-linked polyethylene (commonly abbreviated "PEX") tubing as described in this Notice of Preparation (NOP). Responsible agencies, each of which will be relying on this EIR for the adoption of regulations, will be the Department of Housing and Community Development, Division of the State Architect, Office of Statewide Health Planning and Development, Department of Public Health, and the Department of Food and Agriculture. The purpose of the scoping process is to solicit the views of the responsible and affected agencies and interested members of the public. The principal goal of this NOP is to inform agencies and the public about issues related to the project and request information on the scope and content of the EIR. We encourage recipients of this notice to inform others who may have an interest or responsibility regarding the adoption of PEX regulations that this NOP is available for review.

## *Project Title*

Adoption of Statewide Plumbing Regulations Allowing the Use of PEX Tubing

**Project Location**: Statewide

### *Deadline for Submitting Comments*

Comments must be received no later than 5:00 p.m. on November 30, 2007.

[1] Please note that an earlier administrative draft version of the Notice of Preparation may have been inadvertently distributed to a few recipients. This version, dated October 31, 2007, constitutes the formal Notice of Preparation for the PEX environmental review process. If you did receive an earlier version of this document please disregard it. Comments on the scope of issues the environmental document should address need to be based on this document.

***Project Description***

The California Building Standards Commission proposes the adoption of new state plumbing code regulations that would allow the use of cross-linked polyethylene (PEX) tubing in various cold and hot water plumbing (including potable water) applications. PEX tubing is a high-density material that is an alternative to ferrous and non-ferrous piping for water distribution. The adoption of new regulations is considered a project as defined in Section 21065 of the California Environmental Quality Act (CEQA) and must therefore comply with the provisions of the Act.

The proposed regulations would apply to all occupancies, including commercial, residential, and institutional building construction, rehabilitation, and repair in all areas of the State. Residential buildings include single-family dwellings, apartment houses, hotels, and motels. Institutional buildings would include schools, hospitals, and other uses.

PEX tubing is currently allowed and is used in California for potable water pipe in hydronic heating systems and manufactured homes. For the majority of existing and residential buildings in California, potable water pipe is made of metal, though chlorinated polyvinyl chloride (CPVC) plastic pipe has recently been approved for use in residential buildings.

The project is limited to the consideration and possible adoption of plumbing regulations to allow use of this alternative water-distributing piping material in applications under the jurisdiction of all California cities, city and county, counties and state agencies. The EIR will not involve the assessment of any specific project that involves direct construction or modification to structures. Therefore, the environmental review process is not location-dependent relative to the boundaries of the State of California. In addition, the EIR will not evaluate the use of PEX/Aluminum/PEX (also known as PEX-AL-PEX).

The following table and text are excerpted from "The Express Terms for the Building Standards of the Building Standards Commission Regarding the Adoption of Amendments into the 2007 California Plumbing Code (CPC) California Code of Regulations, Title 24, Part 5." The proposed changes to the regulations are as follows, with proposed deletions shown in strikeout and proposed additions in underline.

**UPC TABLE 6-4**

| Material | Water Distribution Pipe and Fittings | | Building Supply Pipe and Fittings |
|---|---|---|---|
| | Hot | Cold | |
| Asbestos – Cement | | | X |
| Brass | X | X | X |
| Copper | X | X | X |
| Cast Iron | X | X | X |
| CPVC | X | X | X |
| Galvanized Malleable Iron | X | X | X |
| Galvanized Wrought Iron | X | X | X |
| Galvanized Steel | X | X | X |
| PE | | | X |

| UPC TABLE 6-4 | | | |
|---|---|---|---|
| Material | Water Distribution Pipe and Fittings | | Building Supply Pipe and Fittings |
| | Hot | Cold | |
| PE-AL-PE | X | X | X |
| PEX | X | X | X |
| PEX-AL-PEX 1 | X | X | X |
| PVC | | | X |

1. [BSC, HCD, DSA] The use of ~~PEX and~~ PEX-AL-PEX in potable water supply systems is not adopted ~~for applications under the authority of the California Building Standards Commission, the Division of State Architect and the Department of Housing and Community Development.~~

**604.1**

*Exceptions:*

~~***(2) [For OSHPD 1, 2, 3 & 4]*** *Use of PEX piping is not permitted for applications under the authority of the Office of Statewide Health Planning and Development.*~~

~~***(4) [For BSC]*** *Use of PEX piping is not adopted for applications under the authority of the Department of Health Services and the Department of Food and Agriculture.*~~

**604.11 PEX.** . ~~***[Not Adopted by BSC, HCD, DSA/SS, DHS, AGR & OSHPD 1, 2, 3 & 4]***~~ Cross-linked polyethylene (PEX) tubing shall be marked with the appropriate standard designation(s) listed in Table 14-1 for which the tubing has been listed or approved. PEX tubing shall be installed in compliance with the provisions of this section.

**604.11.1 PEX Fittings.** . ~~***[Not Adopted by BSC, HCD, DSA/SS, DHS, AGR & OSHPD 1, 2, 3 & 4]***~~ Metal insert fittings, metal compression fittings, and cold expansion fittings used with PEX tubing shall be manufactured to and marked in accordance with the standards for the fittings in Table 14-1.

**604.11.2 Water Heater Connections.** . ~~***[Not Adopted by BSC, HCD, DSA/SS, DHS, AGR & OSHPD 1, 2, 3 & 4]***~~ PEX tubing shall not be installed within the first eighteen (18) inches (457mm) of piping connected to a water heater.

### *Environmental Effects to be Examined in the Program EIR*

The purpose of an EIR is to examine a project for potentially significant environmental consequences and to identify measures that can reduce or avoid (mitigate) potential adverse impacts. The EIR will focus on aspects of the project with the potential to cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment. Environmental factors identified as important for the proposed adoption of statewide regulations allowing the use of PEX tubing including the following:

**Water Quality**
The EIR will evaluate the potential for permeation of chemicals through PEX tubing, and the leaching of chemicals from PEX tubing.

**Solid Waste**
The use of PEX tubing could result in an increase in solid waste generation if it is not recycled. Assuming PEX tubing is not recycled or somehow reused, it would likely be sent to a landfill for disposal. Therefore, the use of PEX tubing could potentially increase the volume of waste material requiring disposal in landfills. The EIR will evaluate this issue.

**Air Quality**
The installation and repair of PEX tubing does not require the use of welding, primers, solvent-based adhesives, or glues, and this issue will be documented in the EIR. However, the manufacture and incineration of PEX tubing has the potential to release toxic compounds into the environment which may violate air quality standards, and these issues will be evaluated in the EIR. The EIR will also examine potential emissions of toxic smoke from PEX tubing in the event of fires.

**Public Health**
The EIR will evaluate the formation of biofilm in PEX tubing. The term “biofilm” is used to describe a layer of microorganisms in an aquatic environment held together in a matrix attached to a surface. All forms of water distribution pipe, including PEX, contribute to biofilm formation. Biofilm in PEX piping could potentially contain Legionella. Because Legionella is a human pathogen, the growth of biofilm in PEX piping could cause a substantial adverse effect on human beings. The EIR will also examine the extent to which the use of PEX tubing may affect fire hazards.

In addition, other potentially adverse environmental impacts may arise as the proposed project is examined and evaluated and would also be addressed in the EIR. The purpose of this NOP is to encourage interested parties to submit recommendations on the scope, focus and content of the EIR to the lead agency for consideration.

This NOP is being circulated for a 30-day public review period. Because of time limits mandated by state law, comments should be submitted as soon as possible and must be received no later than November 30, 2007.

Please send written comments concerning the scope and content of the EIR to:

California Department of General Services, Real Estate Services Division
Professional Services Branch, Environmental Services Division
707 Third Street, Suite 3-400
West Sacramento, CA 95605
Attn: Valerie Namba, Senior Environmental Planner
Telephone: (916) 376-1607
Email: valerie.namba@dgs.ca.gov

When responding to the NOP, please identify a contact person who would be available to answer any questions regarding your comments. Documents related to the proposed project are available for review at the DGS RESD address listed above.

DGS will be hosting several public scoping meetings to give the public an opportunity to appear and comment on the scope, focus, and content of the EIR. The public scoping meetings have been scheduled at the following locations and times:

**Public Scoping Meetings**

| City | Location | Address | Date | Time[2] |
|---|---|---|---|---|
| Sacramento | Public Meeting Room | 915 Capital Mall<br>Room 587<br>Sacramento, CA 95814<br>City Parking Lot at 10th & L<br>Parking Garage at 9th & L | November 13 | 1–5 p.m. |
| San Diego | Public Auditorium | 1350 Front Street<br>Auditorium -Room B-109<br>San Diego, Ca 92101 | November 14 | 9 a.m.–12 p.m. |
| Riverside | Cesar Chavez Community Room | 2060 University Avenue<br>Riverside, CA 92522 | November 15 | 1–3 p.m. |
| Burbank | City Council Chamber | 275 Olive Ave<br>Second Floor<br>Burbank, CA 91502 | November 16 | 9 a.m.–1 p.m. |
| Redding | Redding Public Library | 1100 Parkview Avenue<br>Redding, CA 96001 | November 19 | 1–3 p.m. |
| Fresno | Public Meeting Room | 2550 Mariposa Mall<br>Room 1036<br>Fresno, CA 93721 | November 20 | 1–3 p.m. |
| Santa Clara | Redwood Room | Central Park Library<br>2635 Homestead Rd<br>Santa Clara, CA 95051 | November 29 | 1–5 p.m. |

**NOTE**: The meeting rooms for the scoping meetings are accessible to people with disabilities. If translation services are needed or if additional accommodations for the disabled are needed, please notify Ms. Valerie Namba (at 916-376-1607 or valerie.namba@dgs.ca.gov) no later than 2 business days prior to the meeting.

Those persons wishing to participate further in the CEQA process or learn more about the agenda for each of the proposed meetings can contact Valerie Namba at (916) 376-1607 or valerie.namba@dgs.ca.gov.

[2] **Start times are firm, but meetings may conclude early based upon attendance.**

# APPENDIX B

Scoping Summary

# SUMMARY OF SCOPING ISSUES REGARDING PEX TUBING

# JANUARY 11, 2008

## SCOPING PROCESS

A notice of preparation (NOP) of an environmental impact report (EIR) regarding PEX tubing was issued on October 31, 2007. This initiated a 30-day period in which comments will be received concerning the scope and content of the EIR. The scoping period closed on November 30, 2007. During the 30-day period, a series of public scoping meetings was held to inform agencies and the public about the proposed project and to provide opportunity for the public to comment on the NOP and for issues to be evaluated in the EIR. Seven public scoping meetings were held:

| Public Scoping Meetings | | | |
|---|---|---|---|
| City | Location | Address | Date |
| Sacramento | Public Meeting Room | 915 Capital Mall<br>Room 587<br>Sacramento, CA 95814 | November 13 |
| San Diego | Public Auditorium | 1350 Front Street<br>Auditorium -Room B-109<br>San Diego, Ca 92101 | November 14 |
| Riverside | Cesar Chavez Community Room | 2060 University Avenue<br>Riverside, CA 92522 | November 15 |
| Burbank | City Council Chamber | 275 Olive Ave<br>Second Floor<br>Burbank, CA 91502 | November 16 |
| Redding | Redding Public Library | 1100 Parkview Avenue<br>Redding, CA 96001 | November 19 |
| Fresno | Public Meeting Room | 2550 Mariposa Mall<br>Room 1036<br>Fresno, CA 93721 | November 20 |
| Santa Clara | Redwood Room | Central Park Library<br>2635 Homestead Rd<br>Santa Clara, CA 95051 | November 29 |

Comments (either written or verbal) were solicited from agencies and other interested parties.

## INFORMATION ABOUT PUBLIC COMMENTS AND COMMENTERS

During the public comment period, written comments were received from 55 parties:

- 2 local agencies
- 3 organizations
- 47 private companies
- 3 private individuals

At the seven public scoping meetings, a total of 95 people signed in as attending. Of those, 48 people spoke. Participation at the meetings was as follows:

| Location | | Attendees | Speakers |
|---|---|---|---|
| Sacramento | | 18 | 2 |
| San Diego | | 15 | 13 |
| Riverside | | 21 | 13 |
| Burbank | | 15 | 7 |
| Redding | | 7 | 3 |
| Fresno | | 10 | 4 |
| Santa Clara | | 9 | 6 |
| | Total | 95 | 48 |

# SUMMARY OF PUBLIC COMMENTS

More than 50 letters were received and more than 40 people's concerns were heard during the public comment period on the NOP. The commenters ranged from representatives of public agencies to business owners and private organizations. Several common themes could be identified among the comments received. The following points summarize the most commonly heard and EIR-relevant concerns, without attempting to qualify, explain, or respond to them.

## SUPPORT FOR PEX

- PEX should be allowed as an option in California.
- PEX leaks far less than copper piping.
- There has been great success using PEX tubing.
- There is no need for a torch to solder the piping together. There is less fire risk with PEX.
- A number of letters expressed support for the November 27, 2007 California Professional Association of Specialty Contractors (CALPASC) letter.
- Kidney dialysis machines use PEX tubing, so it should be allowed for domestic water supply.
- PEX tubing is a better choice as a nonmetallic material alternative to CPVC for avoiding corrosive water.
- With PEX, there are no connections behind the wall, which reduces the chance for mold. Mold should be discussed in the EIR.
- PEX is flexible, so it is used in areas with seismic concerns.

## PROBLEMS WITH COPPER PIPE

- Holes form in copper, causing leaks.
- Copper leaks slowly over time, unlike PEX. This can lead to mold.
- A torch is needed to solder the piping together, creating a fire hazard.
- Fumes from water soluble flux are a health issue for some.
- Copper pipes leak as a result of nail penetration.
- Copper bursts in cold environments (unlike PEX).
- Copper prices are rising, unlike PEX.
- Corrosion of copper piping is contaminating the San Francisco Bay.
- Copper mining is environmentally damaging, and must be transported large distances from mines.
- Copper leaches into drinking water from copper pipes.
- Copper is failing because water disinfectant has changed from chlorine to chloramine (causing corrosion). This is a result of new technologies that have developed over the past 10 years.
- Aggressive soil and water eats pinholes in pipes.
- Water hammer (small cracking noise). Noise can't be fully mitigated with felt.

## INSTALLATION

- Review whether PEX tubing should be allowed to be installed under concrete slabs. Consensus is that PEX tubing should not be installed under slabs.
- PEX should be installed only above the slab so petroleum byproducts don't permeate into tubing.
- In some island sink installations, you may want to do a sleeving of PEX tubing inside of an AVS plastic.

## FIRE SAFETY

- Polyethylene will continue to burn and can spread fire even after the heat source is removed.
- No need for a torch to solder the piping together. Less fire risk with PEX.
- Firestop products are now mandatory and are required by all model building codes.
- Training includes firewalls. PEX firewall penetration training has UL ratings and Canadian ratings for smoke, fire, and fire spread.

## PREMATURE DEGRADATION

- California should consider requiring a level of chlorine performance for all approved PEX products.
- Issues of chlorinated water and UV exposure should be considered in EIR.
- There is no evidence that PEX is susceptible to attack by oxidants and can be damaged by UV radiation, leading to premature failure.
- There is no evidence of unusual or widespread PEX failures.

## WATER QUALITY

- Allegations that PEX tubing could leach organic compounds are unfounded.
- Corrosion of copper piping is contaminating the San Francisco Bay.

## SOLID WASTE

- PEX can be recycled, just like any plastic. PEX could be removed and reinstalled in another building.
- The EIR should reflect that the manufacture, installation, use, collection, and disposal of any material will have impacts on the environment.
- Copper recycling creates toxic dust and requires significant energy.
- EIR should look at amount of solid waste produced from failures of existing systems (drywall, wood, etc.)
- PEX lasts longer than copper, reducing the amount of waste generated during repipes.
- Scrap pieces from jobsites are taken to a recycle spot because it is plastic.
- Manufactured scrap PEX is being used in composite wood materials.
- PPFA is preparing a life cycle inventory report on plastic versus metal piping systems.

## BIOFILM/MICROBIAL

- We are unaware of any evidence that PEX may promote the growth of the Legionella pathogen. There is no evidence that PEX piping presents any greater risk to human health or water quality from biofilm formation than any other code-approved material.
- Microbial problems exist with all types of piping. EIR should compare PEX biofilm issues to other piping.
- EIR should look at internal microbial corrosion in copper pipe (blue water).

## MISCELLANEOUS

- Include an analysis of climate change/carbon implications of proposed regulations. Copper is heavier, and requires more fuel to transport. Large fossil fuel use associated with copper mining, processing, transporting.
- PEX tubing in an approved material in the International Plumbing Code, International Residence Code, and the Uniform Plumbing Code. These plumbing codes require PEX tubing to be third-party certified to applicable standards, including NSF/ANSI Standard 14 and NSF/ANSI Standard 61.
- The discussion of the no project alternative in the PEX EIR should include the evidence from the CPVC recirculated draft EIR.
- There is simply no evidence that PEX will result in significant adverse impacts on the environment or human health, and in fact, there is evidence that full PEX adoption can save Californians money, energy, and water.
- EIR should look at positive factor of water conservation associated with PEX tubing use (manifold system). Smaller pipe size with PEX reduces amount of water flow and allows hot water to arrive faster.

# COALITION FOR SAFE BUILDING MATERIALS COMMENTS

In addition to the comments listed above, comments received by the California Building Standards Commission (BSC) from the Coalition for Safe Building Materials[1] in 2005 are also being considered for scoping purposes by the EIR preparer, but will not be included or referenced as scoping comments for the purposes of this EIR.

## CLASSES OF PEX

- Adequate examination of the potential impacts of PEX requires an analysis of the different classes of PEX and the various additives and recipes for making PEX.
- Because the proposed regulations approving PEX do not differentiate between different classes of PEX (i.e., PEX-A, PEX-B, and PEX-C), environmental review under the California Environmental Quality Act must include evaluation of the potential impacts of all three types of PEX.

## CHEMICAL LEACHING

- Chemicals such as MTBE, TBA, and other aromatic hydrocarbons may leach directly out of PEX tubing and contaminate drinking water at levels that exceed California standards.
- PEX manufacturers have not disclosed to the state agencies sufficient information to allow for a meaningful assessment of the leaching characteristics and potential hazards of their product.
- Certification under the ANSI/NSF Standard 61 does not refute the chemical leaching potential of PEX.
- The California Department of Housing and Community Development's (HCD) finding that there is no evidence that PEX may leach dangerous chemicals in contrary to the evidence in the record.

## PEX PERMEATION

- Pesticides, termiticides, benzene, gasoline constituents, and other toxic chemicals may permeate PEX tubing and enter drinking water.
- PEX is susceptible to permeation by a number of commonly encountered construction materials, including pipe thread and fire wall sealing compounds.

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[1] The Coalition for Safe Building Materials is a coalition of the California Pipe Trades Council, California Professional Firefighters, Consumer Federation of California, Planning and Conversion League, Center for Environmental Health, Sierra Club of California and Communities for a Better Environment.

## PREMATURE FAILURE

- PEX tubing may degrade prematurely and rupture due to exposure to numerous commonly encountered materials and environmental conditions. This could cause water damage to homes and could potentially result in black mold.
- PEX is susceptible to chemical attack from oxidizers such as chlorine and oxygen, and exposure to UV rays.
- Common municipal disinfectant additives, such as chlorine and chloramines, increase the ORP values of the water and is directly correlated with premature failures.
- The susceptibility of the different types and brands of PEX to prematurely fail cannot be determined without full disclosure of the type of antioxidants used in each type of PEX.
- HCD's finding that there is no evidence that PEX may prematurely fail due to its similarities to PB is contrary to the evidence in the record.
- HCD's finding that there is no evidence that PEX is subject to attack by chlorine water is contrary to the evidence in the record.

## BIOFILMS

- PEX tubing may promote the growth of biofilms containing dangerous microbes such as Legionella.
- The susceptibility of PEX to the formation of biofilm may lead to both significant health impacts and to premature failure of PEX.

## SOLID WASTE

- PEX tubing may not be recyclable and thus presents solid waste disposal issues.
- The only current recycling method for PEX is to grind it down and use it as filler for another material.

## FIRE HAZARDS

- PEX tubing may pose a fire hazard.
- The Commission should, at a minimum, identify which firestopping materials are appropriate for use with PEX and provide such guidance in the regulations.

# APPENDIX C

NSF/ASTM Chlorine Degradation Memorandum

ENSR | AECOM

**ENSR**
2 Technology Park Drive
Westford MA 01886
T 978-589-3000 F 978-589-3100 www.ensr.aecom.com

## Memorandum

Date: April 7, 2008

To: Heather Halsey/EDAW

From: Ishrat S. Chaudhuri, Ph.D., DABT/ENSR

Subject: Comparison of chlorine resistance standards for PEX piping

Distribution:

As you requested, these are my thoughts on the differences between the ASTM 2023 standard and the NSF 171-Cl-R and NSF 171-Cl-TD standards.

- Definitions – NSF 171-Cl-TD (traditional domestic) and Cl-R (recirculating hot water) are based on the differences between traditional hot water piping installations and domestic continuous recirculation hot water systems. The traditional system is defined as being exposed to hot water only during hot water draw, which is estimated at 25% of the time, while recirculating systems expose the piping to the hot water 100% of the time. Continuous recirculation residential hot water systems are a relatively new residential application (www.flowguardflex.com/Brochures/PE_reprint.pdf). ASTM 2023 only evaluates traditional piping systems, and not the continuous recirculation systems.
- The actual laboratory testing method in these standards are similar. Both the ASTM and NSF methods involve testing the end-use PEX piping under pressure in a flowing water system simulating worst-case use conditions. They require samples to be exposed to highly oxidative environments and tested until failure. According to Patrick Vibien of Jana Laboratories (905-726-8550, ext 252; personal communication on 3/26/08), Jana Laboratories conducts testing of PEX piping for both of these methods. Testing is done under conditions of continuously flowing hot water at 239, 221 and 203 F.
- There is a difference in the number of required data points between the ASTM and NSF methods. The ASTM procedure states "Time-to-failure data points shall be obtained at 2 test hoop stresses at each of a minimum of 3 test temperatures for a minimum of 12 data points." The NSF procedure states "A minimum of 2 failure points is required per test condition, with a minimum of 5 failure points at the highest temperature and pressure condition, for a minimum total of 17 failure points overall." So the NSF procedure has a higher requirement for testing data points.

**ENSR**
2 Technology Park Drive
Westford MA 01886
T 978-589-3000 F 978-589-3200 www.ensr.aecom.com

- The differences between the methods are in the extrapolations conducted with the data, and the product specifications needed to pass the test. An equation called Miner's rule is applied to figure out pipe lifetimes assuming 25% hot water and 75% cold water.

  - ASTM 2023 - Products that meet this requirement have a minimum extrapolated test lifetime of 50 years at the end-use conditions of 25% of the time at 140$^o$F and 75% of the time at 73$^o$F with 80 psig constant internal gauge pressure.
  - NSF 171-Cl-TD - Products that meet this requirement have a minimum extrapolated test lifetime of 80 years at the end-use conditions of 25% of the time at 140$^o$F and 75% of the time at 73$^o$F with 80 psig constant internal gauge pressure.
  - NSF 171-Cl-R - Products that meet this requirement have a minimum extrapolated test lifetime of 80 years at the end-use conditions of 100% of the time at 140$^o$F with 80 psig constant internal gauge pressure.

  A document by Volgstadt, 2004 (www.flowguardflex.com/Brochures/PE_reprint.pdf) provides a summary table highlighting the differences. Both of the NSF standards are more stringent because they have a test lifetime of 80 years (the standard uses a design factor of 0.5, so the actual standard specifies a lifetime of 40 years), compared to the ASTM test lifetime of 50 years. NSF-171-Cl-R is the most stringent test since it evaluates the pipe under conditions of hot water 100% of the time. Therefore, PEX piping that meets the NSF standard automatically meets the ASTM standard, but not vice versa.

- According to Patrick Vibien of Jana Laboratories, testing results conducted under the ASTM 2023 method can be extrapolated to determine whether the product meets NSF 171-Cl-TD or NSF 171-Cl-R tests. For example, Volgstadt (2004) discusses testing a type of PEX piping in general accordance with ASTM 2023 and NSF 171. The testing was conducted at eight different temperature and pressure conditions with a total of 16 failure points generated. The test results were extrapolated to the end use condition of 140$^o$F, 80 psig for continuous recirculation. The PEX piping was shown to have an extrapolated test lifetime of 93 years. Therefore, this particular PEX piping met ASTM 2023, NSF-171-Cl-TD and NSF-171-Cl-R standards. However, if the extrapolated test lifetime was 50 years under the end use condition of 25% hot water and 75% cold water, then this particular type of PEX piping would have met the ASTM 2023 standard, but not either of the NSF standards.
- The NSF standard was developed first and is not an industry consensus standard. ASTM was developed later and is an industry consensus standard.
- For traditional domestic requirements (25% hot/75% cold), pipes that meet the ASTM 2023 standard should be acceptable. However, ASTM 2023 was not meant to test for 100% continuously recirculating hot water, so simply meeting this standard would not be sufficient for systems with 100% hot water. For these systems, the ASTM test results could be used to extrapolate to 140F for 100% of the time, or the pipe should show compliance with NSF 171-Cl-R.

# APPENDIX D

Fire Manual

# Firestopping

# Plastic Pipe in Fire Resistive Construction

By Eva Ackerman, RectorSeal
Dr. Yarwei Cen, RectorSeal
Robert C. Wilging, psi (Mpa)

# PPFA

# Plastic Pipe and Fittings Association

# Table of Contents



## Introduction

The material in this manual has been assembled by the Plastic Pipe and Fittings Association and is published as a guide for proper firestopping of plastic pipe penetrations in fire resistive construction. Its purpose is to provide builders, engineers, architects, and mechanical-plumbing contractors information about the materials and products used in firestopping plastic piping. It also provides some general information about the proper installation of those materials and products.

A variety of devices, materials and products used individually or in combination with one another are used in firestops. These firestops have been developed for plastic piping penetrations of fire rated barriers so that the fire rating of the barrier is maintained. Installers must carefully follow the manufacturer's instructions when using their materials, products or devices.

New plastic piping materials are constantly being developed. Also new firestopping materials and devices are being developed and tested. In addition, the construction industry is being encouraged to adopt new technology for building fire protection. Current information is available on the websites listed at the back of this manual.

The evaluation of walls, floors and floor/ceiling assemblies to determine their fire resistance rating is done by subjecting large-scale assemblies to fires that produce established time/temperature conditions in a large furnace. The tests are done in accordance with ASTM E 119, Standard Test Methods for Fire Tests of Building Construction and Materials. The results of these tests provide the Fire Resistance Ratings that are expressed in terms of hours. Building codes, in turn, require certain barriers to have minimum fire resistance ratings. The hourly rating depends on the building size, height and occupancy plus other factors.

There are a great many wall designs However, no matter what wall design is used, the primary question concerning a firestop for a plastic pipe penetrating a rated barrier is always which materials when used in conjunction with which plastic pipe will achieve a one-, two- or three-hour rating that is needed to match (or exceed) the rating of the barrier.

## Important Notice

The statements, descriptions, drawings, and other materials in this manual are informational only; and should not be construed as and are not intended to be an endorsement of any product, system or application. No warranty or representation is made to the fitness of any product or system for a particular purpose or to the suitability of any product or system for a specific application.

**Firestops – Firestop systems – Fire Stops**
ASTM E 814defines firestops as follows: "*firestop* – a through-penetration fire stop is a specific construction consisting of the materials that fill the opening around penetrating pipes and their means of support through the wall or floor opening to present spread of fire."

The UL Directory states: "A firestop is a specific construction consisting of a wall or floor assembly, a penetrating item passing through an opening in the wall or floor assembly, and the materials designed to prevent the spread of fire through the opening." In the directory, each page has the heading THROUGH PENETRATION FIRESTOP SYSTEMS, but listings are identified only as System No XXXXX.

*These three terms are used interchangeably in this manual.*

Before doing any firestopping, the installer should obtain approval from the building inspector, the Code Official, or the project engineer. All firestops must pass ASTM E 814 (or UL 1479) tests and be listed by an approved agency. A firestop can consist of a device, several components or materials used in a specific way in order to meet the hourly rating needed. Individual components or materials are not assigned ratings. Modifying a listed firestop by substitution or elimination of specific components is not permitted unless stated in the listing.

Some variable of the F and T rating of a firestop are:

Pipe material, pipe size or pipe wall thickness;
Wall material, e.g., concrete block, wood or steel framed gypsum board
Wall thickness, wall rating (hours)
Floor slab thickness, fire rating (hours)
Floor/ceiling materials/thickness, fire rating (hours)

## Firestopping Questions and Answers

**Q: What is a plastic pipe firestop?**

A: It is a device, a material or a combination of materials used to fill or seal a pipe penetration so that the fire integrity of the rated barrier (wall or floor) is maintained whenever it is penetrated by the plastic pipe.

**Q. How are plastic pipe firestops tested to verify their performance?**

A. This is done by building a section of wall, floor, or floor/ceiling assembly with the plastic pipe and firestop in place. The complete unit is subjected to a fire test that meets the requirements of ASTM E 814 (or UL 1479). In order to qualify as a “listed” or “classified” firestop, it must resist the passage of flame and temperature for the prescribed time period that equals the barrier rating in “hours.” Note: Some codes prescribe only an “F” rating and no “T” rating.

**Q: Why is a firestop needed?**

A: Firestops are required by all building codes whenever fire barriers (walls or floors) are penetrated by piping. Firestops can play a significant roll in controlling the spread of fire and smoke.

**Q: How do firestops work?**

A: The fill and/or cover the annular space around pipes penetrating walls and floors. Most firestops contain materials that intumesce, (expand) in the presence of heat. This action seals the penetration if heat softens the pipe.

**Q: What information is needed to select an acceptable firestop?**

A: Type of barrier, wall or floor; its material, its thickness, and its fire rating in hours.
The pipe material; size of pipe; schedule or series of pipe that indicates wall thickness.
The size of the hole and the annular space.
The pipe’s position in the hole (centered or off-center).

**Q: How can firestopping be done to meet code requirements?**

A: Gather all the necessary information. Select a listed firestop. Get the right product, and carefully follow all the installation instructions.

**Q: Will the firestopping serve as a pipe support?**

A: No. All codes call for proper support of piping and give some support spacing. They make no reference to the firestop as a portion of the support.

## Tests for Fire-rated Barriers & Firestops

**ASTM E 119**

Standard Test Methods for Fire Tests of Building Construction and Materials (ASTM 119) was first published in 1917. This method is intended to evaluate the duration for which the types of assemblies will contain a fire or retain their structural integrity or both during a predetermined fire test exposure. The test exposes a specimen to a *standard fire* that is controlled to achieve specified temperatures over a specified time period. In some instances the *fire exposure* may be followed by a standard *fire hose stream*. The results of a Fire Endurance Test plus a Hose Stream Test provide a “fire rating” for a barrier (wall or floor) expressed in hours. If a firestop is to be tested using an E 119 wall or floor, the test specimen must meet the minimum E 119 dimension requirements – 100-sq. ft. for a wall or 180-sq. ft. for a floor. Since such large-scale tests are expensive, ***several firestops*** can be tested in a single assembly. When conducting such a test, some of the firestops may pass the test while others may fail.

**ASTM E 814**

The Standard Test Method for Fire Tests of Through-Penetration Fire Stops (E 814) was first published in 1981. This method is used to evaluate fire stops that are intended for use in openings in fire-resistive walls and floors that have been evaluated in accordance with test method E 119. The E 814 test method utilizes a smaller wall or floor unit with the penetrating item and the firestop in place. The same *fire exposure* and *specified standard* fire hose stream tests used for the E 119 test are applied to the E 814 assembly. The E 814 test method is less costly because a smaller furnace can be used and smaller wall or floor units are used.

**Hose Stream Test**

The hose stream test is conducted on a wall or floor unit with a firestop mounted on it immediately after the unit has been subjected to a fire-exposure test for a period equal to one half that indicated as the resistance period in the fire test. The maximum fire-exposure test shall be not more 60 minutes. During the hose stream test, the firestop shall not develop any opening that would permit a projection of water from the stream beyond the unexposed side.

## Piping Materials, ASTM Standards and Piping Systems

The table shows various plastic materials, the ASTM Standards for the various pipe and fitting products used in piping systems within buildings. Sanitary waste (DWV Drain, Waste and Vent), roof drains, condensate drain plus (hot & cold) water distribution systems are common to all buildings. There are several materials made to different ASTM Standards used for each of these piping systems. It is important to understand that different products may require different firestop systems.

Firestopping for all types of piping systems must be selected on the basis of all the pertinent variables.

| **Material** | **ASTM Standards** | **Application** |
|---|---|---|
| ABS | D2661 and D1527 | DWV<br>Roof Drain |
| ABS Foam Core | F628 | DWV<br>Roof Drain |
| CPVC | D2846<br><br>F441 and F442 | Hot and Cold water distribution<br>Fire sprinklers<br>Corrosive Wastes<br>Condensate Drains<br>Vents-High Efficiency (90%)<br>Furnaces |
| PB | D3309 | Hot and Cold water distribution<br>Fire sprinklers<br>Hydronic Heating |
| PP | F1412 | Chemical waste |
| PEX | F877 | Hot and Cold water distribution<br>Hydronic Heating |
| PVC | D1785 and D2241 | Chilled Water<br>Low Temperature<br>Heating/Cooling<br>Deionized Water<br>Vents-High Efficiency (90%)<br>Furnaces |
| PVC | D2665 and D2949 | DWV<br>Roof Drains<br>Condensate Drains |
| PVC Foam Core | F891 | DWV<br>Roof Drains |

## Testing a Firestop System

A through – penetration firestop system is comprised of four parts:

Fire-rated barrier (floor, wall or floor/ceiling)
The hole or opening
The pipe passing through the barrier
The firestop (device, product or combination of materials)

The barrier may be a wood or metal stud gypsum board wall, a block wall, a concrete floor slab, or a wood floor/ceiling assembly. The thickness of each barrier and the burning characteristics of each material are different so separate tests must be performed with each firestop system. To test a firestop, a section of a barrier with a plastic pipe passing through a hole that is sealed with the firestop is placed on a furnace. Then the fire can be applied to one side while the other side is at normal conditions. During the test, the plastic pipe coming through the firestop is monitored for time of flame through (if it occurs) and for temperature rise Vs time. After the fire test the assembly is removed from the furnace and subjected to the hose stream applied from the hot side to see if it can withstand that force without a visible water stream coming through. This test provides the F rating and T rating values for that firestop (in hours) if the hose stream requirement is met. In ASTM E 814, we find the following Rating Criteria:

### F Rating

A firestop shall be considered as meeting the requirements for an F rating when it remains in the opening during the fire test and hose stream test within the flowing limitations:

“The fire stops shall have withstood the fire test for the rating period without permitting the passage of flame through the openings, or the occurrence of flaming on any element of the unexposed side of the firestops.

“During the hose stream test, the fire stop shall not develop any opening that would permit a projection of water from the stream beyond the unexposed side.” (ASTM E 814)

### T Rating

A firestop shall be considered as meeting the requirements for a T rating when it remains in the opening during the fire test and hose stream test with the following limitations:
“The transmission of heat through the firestop during the rating period shall not have been such as to raise the temperature of any thermocouple on the unexposed surface of the firestop or on any penetrating item more than 325°F above its initial temperature. Also, the firestop shall have withstood the fire test for the rating period without permitting the passage of flame through openings, or the occurrence of flaming on any element of the unexposed side of the firestops.

During the hose stream test, the firestop shall not develop any opening that would permit a projection of water from the stream beyond the unexposed side.” (ASTM E 814)

**Hose Stream**

Subject a duplicate specimen to the fire-exposure test for a period equal to one half of that indicated as the resistance period in the fire test, but shall be not more than 60 minutes, immediately after which subject the specimen to the impact, erosion, and cooling effects of a hose stream as described in Table 2 (below) directed first at the middle and then at all parts of the exposed face, with changes in direction being made slowly.” (ASTM E 814)

Pressure and Duration – Hose Stream Test

| Resistance Period | Water pressure at Base of Nozzle, PSI (kPa) | Duration of Application s/ft$^2$(m$^2$) of exposed area |
|---|---|---|
| **240 minutes and over if less than 480 minutes** | 45 (310) | 3.0 (32) |
| **120 minutes and over if less than 240 minutes** | 30 (210) | 1.5 (16 |
| **90 minutes and over if less than 120 minutes** | 30 (210) | 0.90 (10) |
| **60 minutes and over if less than 90 minutes** | 30 (210) | 0.60 (6) |
| **Less than 60 minutes if desired** | 30 (210) | 0.60 (6) |

“During the Hose Stream Test, the fire stop shall not develop any opening that would permit a projection of water from the stream beyond the unexposed side.” (ASTM E 814)

## Testing Facilities and Listing Agencies

There are many testing laboratories that conduct ASTM tests and do fire testing.  Many also provide listing services. Some of those are as follows:

Factory Mutual Research (FM)
Intertek Testing Services (ITS) (formerly Warnock Hersey – (WH)
Omega Point Laboratories (OPL)
Southwest Research Institute (SRI)
Underwriter’s Laboratories (UL)

# Firestopping in Three Steps

## STEP ONE

Gather all the needed information

1. Type of wall, floor or floor/ceiling/ (wood or steel stud, concrete, gypsum).
2. Fire rating of the barrier.
3. Pipe material (ABS, PVC, CPVC, PEX)
4. Pipe size and wall thickness (Schedule or SDR).
5. Diameter of the hole (inches).
6. Annular space = hole diameter – pipe OD/2.
7. Check with local Code Official to see who inspects installed firestop.

### STEP TWO

Find corresponding listing with drawing

1. Locate a good directory of listed firestop systems, e.g., the UL Fire Resistance Directory; Omega Point Laboratories Directory of Listed Building Products, Materials and Assemblies; or WH Directory.
2. Identify all listed firestop systems based upon information in STEP ONE.
   Select the system that is most suitable for your conditions, taking into account all the variables.
3. Obtain all the materials, products or the device needed, plus the installation drawings and instructions.

### STEP THREE

Apply product according to the drawing and listing details, and manufacturer's instructions.

1. Make sure the information in the Listing and the Installation Drawing and/or manufacturers instructions do not conflict, e.g., type and size of pipe, annular space, etc.
2. Follow the instructions provided in the installation drawing.
3. Check to see whether the annular space seal is needed on both sides of the barrier.

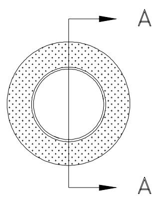
# Typical Installation Procedures

General Installation Information

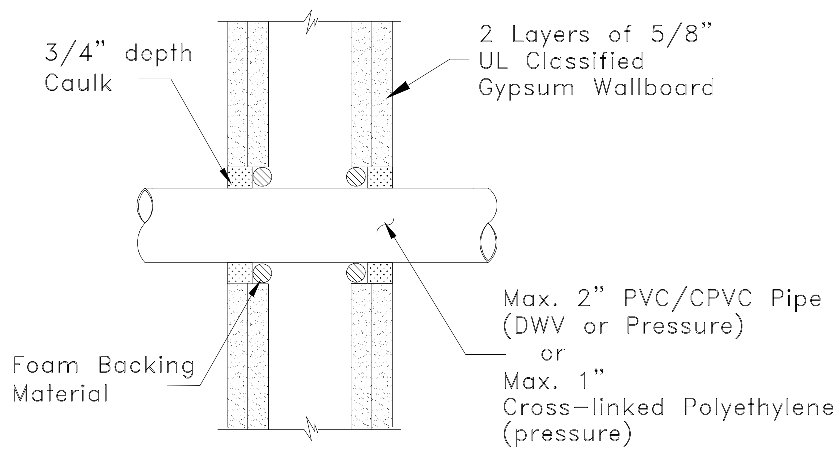
1. All surfaces to which the firestop product is to be applied should be free of dirt and debris.
2. The penetrating pipes should be supported on both sides of the wall or floor. Generally firestop systems provide no support for the pipes.
3. If on-site through-penetration conditions differ from those shown on the installation instructions, contact the manufacturer of the firestop before beginning installation.
4. Carefully follow manufacturer's instructions for the installation of the firestop.

Wall Penetration
2 Hour Rating




ELEVATION




SECTION A–A

| SYSTEM CONFIGURATION INFORMATION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCT(S) | | | PENETRATING ITEM(S) | | | HOLE SIZE | ANNULAR SPACING | | ADDITIONAL INSTALLATION MATERIALS AND AIDS | | | BACKING MATERIAL | | ASTM E 814 RATING | |
| FILL MAT'L | MIN. THICK. | OTHER | TYPE | SIZE | INSULATION | MAX. | MIN. | MAX. | WIRE MESH | STEEL SLEEVE | OTHER | TYPE | DEPTH | T | F |
| caulk | 3/4" both sides | none | PVC/CPVC SCH 40 closed/open<br><br>PEX SDR 9 | up to 2"<br><br>up to 1" | none | 3 5/8" | 5/8" | 5/8" | none | none | none | foam backer rod | N/A | 1 1/2 | 2 |

**INSTALLATION INSTRUCTIONS**

These instructions are for the installation of through-penetration fire stop system in a minimum 5" thick steel or wood stud fire rated gypsum wallboard partitions as listed by Underwriters Laboratories Inc. Refer to above drawings and System Configuration Information for component details.

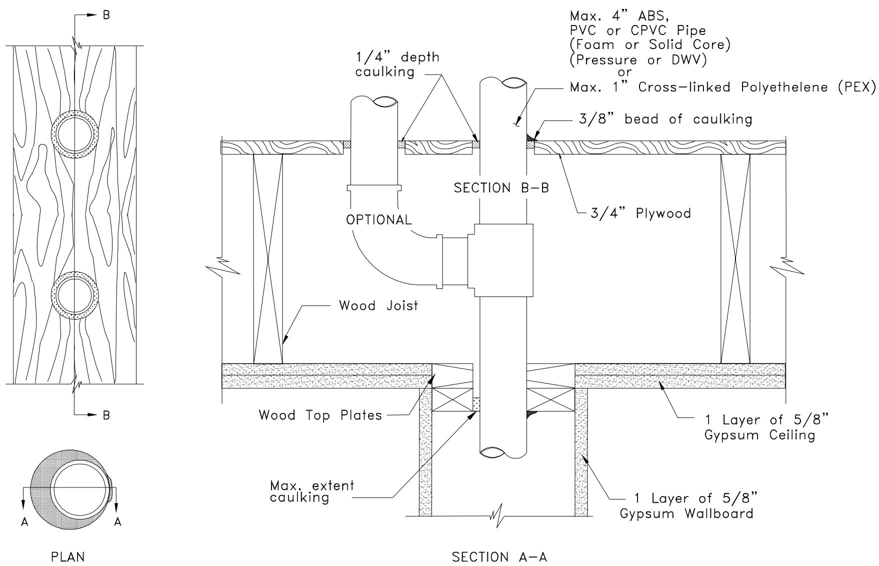
Step Procedure

1 Clean all hole, pipe and insulation surfaces in penetration area to remove loose debris, dirt, oil, wax, grease, old caulking, etc.

2 Install backing material by firmly packing annular space with foam backer rod from both sides of wall. Recess backing material at least 3/4" in from both sides of wall to accommodate the required fill depth of caulk.

3 Gun, trowel and/or pump firestopping sealant to minimum 3/4" depth on both sides of wall. Trowel sealant surfaces flush with wall surfaces and to a smooth defect-free finish.

Floor Penetration
1 Hour Rating



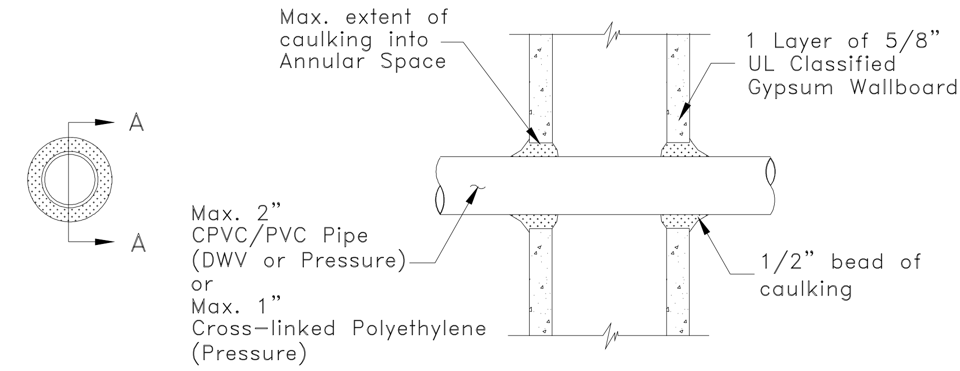

| SYSTEM CONFIGURATION INFORMATION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCT(S) | | | PENETRATING ITEM(S) | | | HOLE SIZE | ANNULAR SPACING | | ADDITIONAL INSTALLATION MATERIALS AND AIDS | | | BACKING MATERIAL | | ASTM E 814 RATING | |
| FILL MAT'L | MIN. THICK. | OTHER | TYPE | SIZE | INSULATION | MAX. | MIN. | MAX. | WIRE MESH | STEEL SLEEVE | OTHER | TYPE | DEPTH | T | F |
| caulk | 1/4" top Max. Extent bottom | none | PVC, ABS (foam or solid core) SCH 40 CPVC SDR17 (or heavier), closed or vented | up to 4" I.D. up to 1" PEX | none | 4 3/4" | 0" | 1/4" | none | none | none | none | N/A | N/A | 1 |

**INSTALLATION INSTRUCTIONS**

These instructions are for the installation of through-penetration fire stop system in a wood floor/ceiling and chase wall construction as listed in the individual L500 floor designs and U300 wall designs, repectively by Underwriters Laboratories Inc. Refer to above drawings and System Configuration Information for component details.

| Step | Procedure |
|---|---|
| 1 | Cut hole in wood floor and top plates to required size to accommodate pipe penetration and allowable annular spacing. Do not exceed maximum specified hole diameter. |
| 2 | Install up to 4 " I.D. ABS, PVC or CPVC(foam or solid core) vented (DWV) or closed (pressure) pipe or up to 1" I.D. PEX tubing. Support pipe rigidly on both sides of floor/ceiling. |
| 3 | Gun, trowel and/or pump sealant to a 1/4" depth in annular space of penetration(s) on top of wood floor and a 3/8" bead at all zero annular spaces. Trowel sealant surfaces flush with floor surface and to a smooth defect-free finish. |
| 4 | Gun, trowel and/or pump sealant to a maximum extent depth in the annular space of wood plates and 3/8" bead at all zero annular spaces. Trowel sealant surfaces flush with bottom of top plates and to a smooth defect-free finish. |

Wall Penetration
1 Hr. Rating




ELEVATION        SECTION A-A

| SYSTEM CONFIGURATION INFORMATION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCT(S) | | | PENETRATING ITEM(S) | | | HOLE SIZE | ANNULAR SPACING | | ADDITIONAL INSTALLATION MATERIALS AND AIDS | | | BACKING MATERIAL | | ASTM E 814 RATING | |
| FILL MAT'L | MIN. THICK. | OTHER | TYPE | SIZE | INSULATION | MAX. | MIN. | MAX. | WIRE MESH | STEEL SLEEVE | OTHER | TYPE | DEPTH | T | F |
| caulk | Max. extent | none | PVC/CPVC SCH 40 closed/open<br>PEX SDR 9 | up to 2"<br>up to 1" | none | 3 5/8" | 5/8" | 5/8" | none | none | none | none | N/A | 1 | 1 |

**INSTALLATION INSTRUCTIONS**

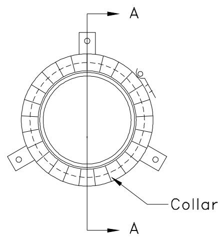
These instructions are for the installation of through-penetration fire stop system in a minimum 5" thick steel or wood stud fire rated gypsum wallboard partitions as listed by Underwriters Laboratories Inc. Refer to above drawings and System Configuration Information for component details.

Step Procedure

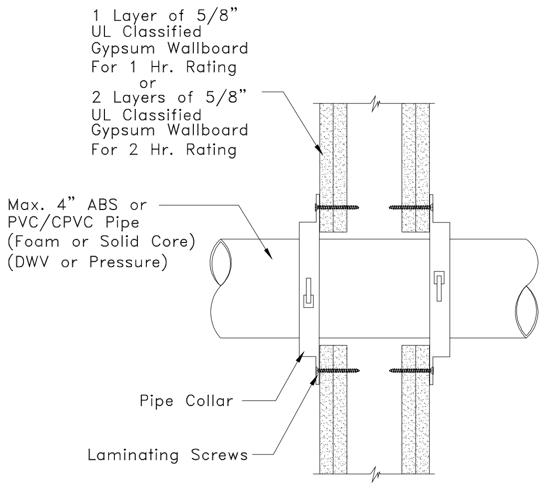
1 Clean all hole, pipe and insulation surfaces in penetration area to remove loose debris, dirt, oil, wax, grease, old caulking, etc.

2 Gun, trowel and/or pump firestopping sealant to the max. extent in the annular space on both sides of wall. Trowel sealant surfaces flush with wall surfaces and to a smooth defect-free finish. Apply 1/2" diameter caulking bead around perimeter of pipe on both sides of wall and tool smooth.

Wall Penetration
1 or 2 Hour Rating




ELEVATION




SECTION A-A

| SYSTEM CONFIGURATION INFORMATION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCT(S) | | | PENETRATING ITEM(S) | | | HOLE SIZE | ANNULAR SPACING | | ADDITIONAL INSTALLATION MATERIALS AND AIDS | | | BACKING MATERIAL | | ASTM E 814 RATING | |
| FILL MAT'L | MIN. THICK. | OTHER | TYPE | SIZE | INSULATION | MAX. | MIN. | MAX. | WIRE MESH | STEEL SLEEVE | OTHER | TYPE | DEPTH | T | F |
| pipe collar | none | none | ABS or PVC/CPVC (foam or solid core) SCH 40 (or heavier), closed or vented | up to 4" I.D. | none | 5" | 1/4"<br>For pipe 3" or less<br>0" | 1/4"<br><br>1/2" | none | none | minimum 1 7/8" laminat-ing screws | none | N/A | 0 | 2 or 1 |

## INSTALLATION INSTRUCTIONS

These instructions are for the installation of through-penetration fire stop system in a minimum 5" thick steel or wood stud fire rated gypsum wallboard partitions as listed by Underwriters Laboratories Inc. Refer to above drawings and System Configuration Information for component details.

Step Procedure

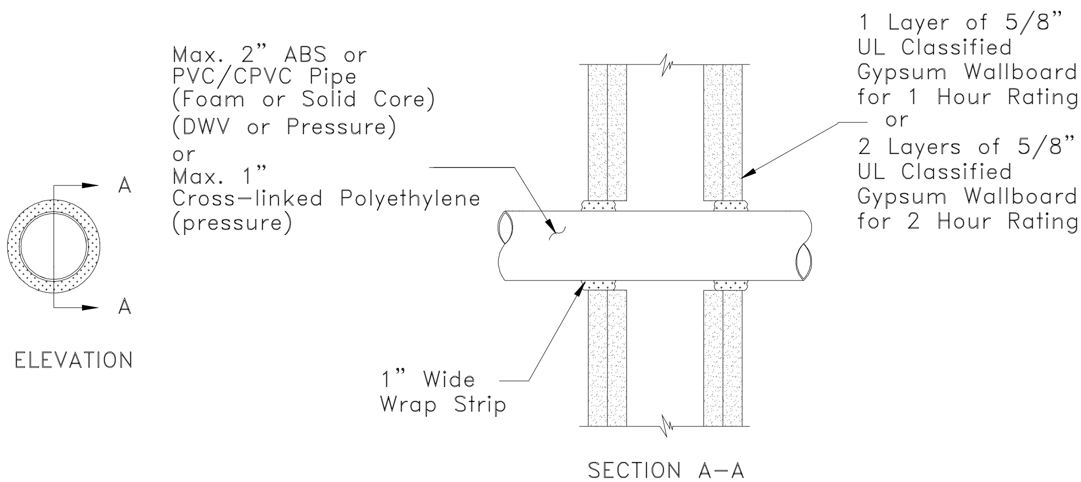
1 Cut hole in gypsum wallboard in required size to accommodate pipe penetration and allowable annular spacing. Do not exceed maximum specified hole diameter.

2 Install up to 4" I.D. ABS or PVC/CPVC(foam or solid core) vented (DWV) or closed (pressure) pipe. Support pipe rigidly on both sides of wall.

3 Clean all hole and pipe surfaces in penetration area to remove loose debris, dirt, oil, wax, grease, old caulking, etc.

4 Install appropriate size Pipe Collar for corresponding plastic pipe diameter on both sides of wall. Secure collar in place through anchor tabs with minimum 1 7/8" gypsum laminating screws.

Wall Penetration
1 or 2 Hour Rating




SYSTEM CONFIGURATION INFORMATION

| PRODUCT(S) | | | PENETRATING ITEM(S) | | | HOLE SIZE | ANNULAR SPACING | | ADDITIONAL INSTALLATION MATERIALS AND AIDS | | | BACKING MATERIAL | | ASTM E 814 RATING | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FILL MAT'L | MIN. THICK. | OTHER | TYPE | SIZE | INSULATION | MAX. | MIN. | MAX. | WIRE MESH | STEEL SLEEVE | OTHER | TYPE | DEPTH | T | F |
| Wrap Strip | 1" both sides | none | ABS or PVC/CPVC pipe, SCH 40 (or heavier) closed/vented PEX SDR 9 | up to 2"I. D.<br>up to 1" | none | 3" | 5/16" | 5/16" | none | none | none | none | N/A | 0 | 2<br>1 |

## INSTALLATION INSTRUCTIONS

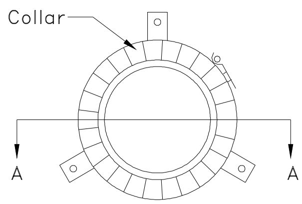
These instructions are for the installation of through-penetration fire stop system in a minimum 5" thick steel or wood stud fire rated gypsum wallboard partitions as listed by Underwriters Laboratories Inc. Refer to above drawings and System Configuration Information for component details.

Step Procedure

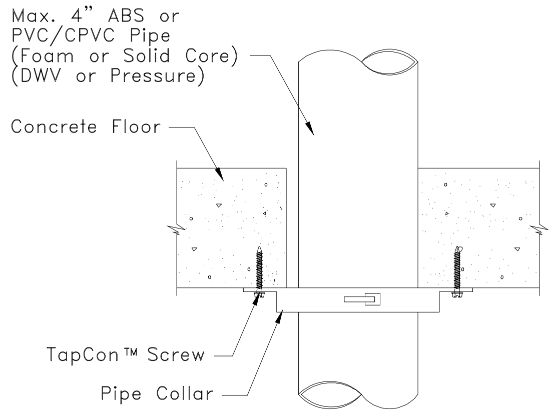
1 Clean all hole and pipe surfaces in penetration area to remove loose debris, dirt, oil, wax, grease, old caulking, etc.

2 Tightly wrap 1 layer of 1" wide Wrap Strip around pipe and secure with tie wire. Recess into annular space such that 1/4" extends beyond the surface of the wall on each side.

Floor Penetration
3 Hour Rating




PLAN




SECTION A–A

| SYSTEM CONFIGURATION INFORMATION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCT(S) | | | PENETRATING ITEM(S) | | | HOLE SIZE | ANNULAR SPACING | | ADDITIONAL INSTALLATION MATERIALS AND AIDS | | | BACKING MATERIAL | | ASTM E 814 RATING | |
| FILL MAT'L | MIN. THICK. | OTHER | TYPE | SIZE | INSULATION | MAX. | MIN. | MAX. | WIRE MESH | STEEL SLEEVE | OTHER | TYPE | DEPTH | T | F |
| pipe collar | none | none | ABS or PVC/CPVC (foam or solid core) SCH 40 (or heavier), closed or vented | up to 4" I.D. | none | 5" | 0" | 1/2" | none | none | 1/4"x1 1/4" concrete anchor screws | none | N/A | 3 | 3 |

## INSTALLATION INSTRUCTIONS

These instructions are for the installation of through-penetration fire stop system in a minimum 4 1/2" thick lightweight or normal weight (100-150 pcf) concrete or hollow-core floors as listed by Underwriters Laboratories Inc. Refer to above drawings and System Configuration Information for component details.

Step Procedure

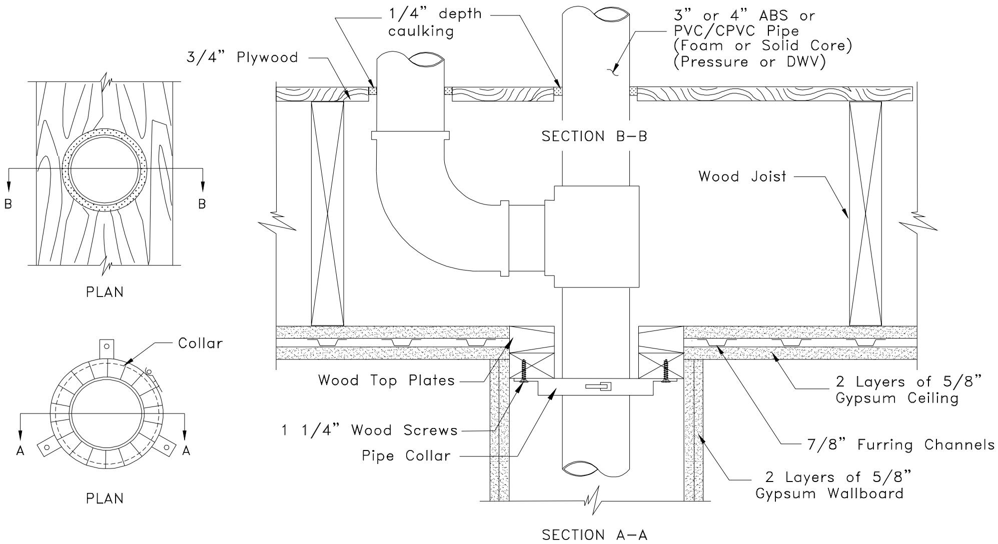
1 Cut hole in concrete floor in required size to accommodate pipe penetration and allowable annular spacing. Do not exceed maximum specified hole diameter.

2 Install up to 4" I.D. ABS or PVC/CPVC(foam or solid core) vented (DWV) or closed (pressure) pipe. Support pipe rigidly on both sides of floor.

3 Clean all hole and pipe surfaces in penetration area to remove loose debris, dirt, oil, wax, grease, old caulking, etc.

4 Install appropriate size Pipe Collar for corresponding plastic pipe diameter on bottom side of floor. Secure collar in place through anchor tabs with 1/4"x1 1/4" TapCon™ concrete anchor screws.

Floor Penetration
2 Hour Rating




| SYSTEM CONFIGURATION INFORMATION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCT(S) | | | PENETRATING ITEM(S) | | | HOLE SIZE | ANNULAR SPACING | | ADDITIONAL INSTALLATION MATERIALS AND AIDS | | | BACKING MATERIAL | | ASTM E 814 RATING | |
| FILL MAT'L | MIN. THICK. | OTHER | TYPE | SIZE | INSULATION | MAX. | MIN. | MAX. | WIRE MESH | STEEL SLEEVE | OTHER | TYPE | DEPTH | T | F |
| pipe collar & 1000 | none 1/4" | none | ABS or PVC/CPVC (foam or solid core) SCH 40 (or heavier), closed or vented | 3" or 4" I.D. | none | 5" | 1/4" | 1/4" | none | none | minimum 1 1/4" wood screws | none | N/A | 2 | 2 |

## INSTALLATION INSTRUCTIONS

These instructions are for the installation of through-penetration fire stop system in a wood floor/ceiling construction as listed by Underwriters Laboratories Inc. Refer to above drawings and System Configuration Information for component details.

Step Procedure

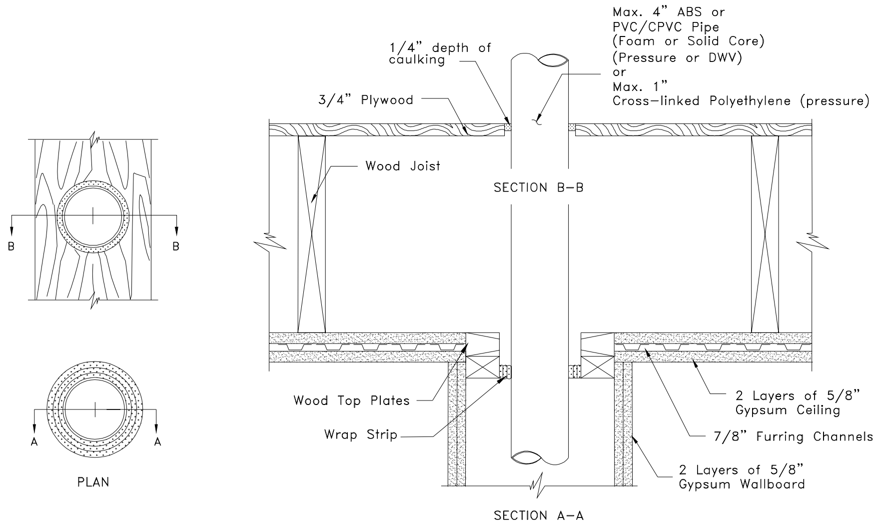
1 Cut hole in wood floor and top plates to required size to accommodate pipe penetration and allowable annular spacing. Do not exceed maximum specified hole diameter.

2 Install 3"or 4 " I.D. ABS or PVC/CPVC(foam or solid core) vented (DWV) or closed (pressure) pipe. Support pipe rigidly on both sides of floor/ceiling.

3 Gun, trowel and/or pump sealant to a 1/4" depth in annular space on top of wood floor. Trowel sealant surfaces flush with floor surface and to a smooth defect-free finish.

4 Install appropriate size Pipe Collar for corresponding plastic pipe diameter on bottom side of wood plates. Secure collar in place through anchor tabs with 1 1/4" wood screws in conjunction with 1/4" x 5/8" washers.

Floor Penetration
2 Hour Rating




| SYSTEM CONFIGURATION INFORMATION | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCT(S) | | | PENETRATING ITEM(S) | | | HOLE SIZE | ANNULAR SPACING | | ADDITIONAL INSTALLATION MATERIALS AND AIDS | | | BACKING MATERIAL | | ASTM E 814 RATING | |
| FILL MAT'L | MIN. THICK. | OTHER | TYPE | SIZE | INSULATION | MAX. | MIN. | MAX. | WIRE MESH | STEEL SLEEVE | OTHER | TYPE | DEPTH | T | F |
| wrap strips & caulk | 1"<br>1/4" | none | ABS or PVC/CPVC (foam or solid core) SCH 40 (or heavier), closed/vented PEX SDR 9 | up to 4" I.D.<br>up to 1" | none | 6"<br>5" | 1/2" (Plates)<br>1/4" (Plywood) | 3/4"<br>1/4" | none | none | none | none | N/A | 2 | 2 |

**INSTALLATION INSTRUCTIONS**

These instructions are for the installation of through-penetration fire stop system in a wood floor/ceiling construction as listed by Underwriters Laboratories Inc. Refer to above drawings and System Configuration Information for component details.

Step Procedure

1 Cut hole in wood floor and top plates to required size to accommodate pipe penetration and allowable annular spacing. Do not exceed maximum specified hole diameter.

2 Install up to 4 " I.D. ABS or PVC/CPVC(foam or solid core) vented (DWV) or closed (pressure) or up to 1" Cross-linked Polyethylene (pressure) pipe. Support pipe rigidly on both sides of floor/ceiling.

3 Gun, trowel and/or pump sealant to a 1/4" depth in annular space on top of wood floor. Trowel sealant surfaces flush with floor surface and to a smooth defect-free finish.

4 Tightly wrap 3 layers of 1" wide Wrap Strip around pipe from bottom side of top plates and recess into annular space flush with bottom surface of top plates. For pipes less than 3", use 2 layers of 1" wide wrap strips.

# Glossary

**ABS Pipe** - Acrylonitrile-Butadiene-Styrene pipe - a plastic pipe used for drains, waste, and vent systems and sewer.

**Annulus or Annuli** - The gap between the penetrating item and the outside edge of the hole.

**ASTM** - American Society for Testing and Materials; an independent consensus standards generating organization composed of volunteers.

**Backer Rod** - A cylindrical polyurethane or polyethylene foam material used to provide support and set the proper depth of material for gunned or troweled in place sealant.

**Backing Material** - Combustible or noncombustible material used to provide support for gunned or troweled in place sealant or caulk.

**Char** - A grayish black, crusty material formed by burning organic type sealants.

**Classification** - A series of procedures, usually administered by an independent testing laboratory, by which the consumer is protected and assured that the product which was tested is the same as the product purchased.

**Closed System** - A piping system which is sealed, typically carrying fluids under pressure, such as hot and cold water distribution. The exact definition on a closed pipe system is determined by the local authority having jurisdiction. For instance, electrical conduit in a vertical orientation through a roof installation may be considered a vented system and the same conduit in a horizontal orientation or penetrating through a floor may be considered closed.

**CMU** - Concrete Masonry Unit, such as concrete block. Usually hollow.

**Cohesion** - The molecular attraction that holds the body of a sealant or adhesive together. The internal strength of an adhesive or sealant.

**Cohesive Failure** - Failure characterized by rupture within the sealant, adhesive, or coating.

**Collar** - A galvanized sheet metal restricting device used in conjunction with plastic pipe. Its function is to direct and control the intumescent action of the firestopping material.

**Compatibility** - The capability of two or more materials when placed in contact or close proximity with one another to maintain their usual physical or chemical properties, or both.

**Concentric** - Having a common center; a pipe centered in the middle of a through-penetration hole results in a concentric annulus.

**CPVC Pipe** - Chlorinated Polyvinyl Chloride pipe - a grade of plastic pipe commonly used for hot/cold water distribution, sprinkler piping, and some chemicals. Suitable for high temperatures.

**Cure** - In sealants, the process by which a compound attains its intended properties through evaporation, chemical reaction, heat, radiation or combinations thereof.

**DWV Pipe** - Non-pressure (vented) piping used for Drain, Waste & Vent (sanitary waste) systems

**Eccentric** - Off center; an eccentric annulus results when a pipe is not centered in the hole.

**Elasticity -** The ability of a material to return to its original shape after removal of a load.

**Elastomer** - A macromolecular material that returns rapidly to approximately the initial dimensions and shape after substantial deformation by a weak stress and release of the stress.

**Elongation** - Extension produced by a tensile stress.

**Endothermic** - A process or change that takes place with absorption of heat and requires high temperature for initiation and maintenance.

**F Rating** - A firestop shall be considered as meeting the requirements for an F rating when it remains in the opening during the fire test and hose stream test within the following limitations: The firestop shall have withstood the fire test for the rating period without permitting the passage of flame through openings, or the occurrence of flaming on any element of the unexposed side of the firestop. During the hose stream test, the firestop shall not develop any opening that would permit a projection of water from the stream beyond the unexposed side. (ASTM E 814)

**Fire Endurance** - A measure of the elapsed time during which a material or assembly continues to exhibit fire resistance under specified conditions of test and performance. As applied to elements of buildings, it shall be measured by the methods and the criteria defined in ASTM E 119 Fire Tests of Building Construction and Materials.

**Fire Rated or Fire Resistance** - A system which has been tested by a qualified laboratory in accordance with the appropriate ASTM test standard and has met the mechanical and endurance requirements of that standard. The property of a material or assembly to withstand fire or give protection from it. As applied to elements of buildings, it is characterized by the ability to confine a fire or to continue to perform a given structural function, or both. Systems are rated for 1, 2, 3 or 4 hours, based on the results of the fire test.

**Fire Resistance Classification** - A standard rating of fire-resistance and protective characteristics of a building construction or assembly. (ASTM E 119)

**Firestop** - A through-penetration firestop is a specific combination of components or materials that fill the opening around wall, floor or ceiling penetrating pipes and their means of support for the purpose of preventing the spread of fire. (ASTM)

**Fire Test Standard** -Fire test standards are procedures intended to measure and describe the response of materials, products, and systems to sources of heat or flame under controlled conditions. These tests are intended to provide information useful for such purposes as product development, quality control, and specification description. They are not intended to be used alone to provide a measure of the fire hazard of materials, products or systems. One or more fire test standards, however, may be used as part of a fire hazard standard. Fire test standards are separate and distinct from fire hazard standards, which are used to describe, measure, assess or control the behavior of materials, products and systems in the relevant environment. (ASTM)

**FM –** Factory Mutual Research; a testing laboratory.

**Intumesce** - To swell, enlarge, inflate or expand, as with heat. Intumescent firestopping sealants swell to close gaps or voids in through-penetration openings when exposed to high heat conditions.

**ITS –** Intertek Testing Services, a testing laboratory.

**Mineral Fiber** - A noncombustible insulation material made from mineral fibers. It is also known as mineral wool or safing material. It is typically used as a backing and filler material in through-penetrations.

**Modulus** - The ratio of stress to strain. Also the tensile strength at a given elongation.

**Material Safety Data Sheet (MSDS)** - A document required by law describing the health and safety aspects of a material as it pertains to its properties, health effects, hazards, handling and disposal.

**Nominal Pipe Size (NPS)–** A term used in pipe and fitting standards and by the trades to refer to the approximate inside diameter for a pipe regardless of pipe wall thickness.

**Non-Sag Sealant** - A compound that exhibits little or no flow when applied in vertical or inverted joints.

**Open System** - An open system or sometimes referred to as a vented system is a piping system which allows air flow to the exterior of the building to prevent back flow or vacuum, i.e.: DWV pipe system (Drain, Waste or Vent or roof drains). The exact definition on an open piping system is determined by the local authority having jurisdiction. For instance, electrical conduit in a vertical orientation through a roof installation may be considered a vented system and the same conduit in a horizontal orientation or penetrating through a floor may be considered closed.

**OPL –** Omega Point Laboratories, a testing laboratory.

**PB Pipe** - Polybutylene pipe; a plastic pipe that is typically used for cold and hot water distribution. It is a material that melts when exposed to heat.

**PE Pipe** - Polyethylene pipe; a plastic pipe that is typically used for gas distribution. It is a material that melts when exposed to heat.

**PP Pipe** - Polypropylene pipe; a plastic pipe that is suitable for higher temperature applications and is typically used for hot and cold water distribution and some chemical services. It is a material that melts when exposed to heat.

**Pressure System –** see Closed System

**PVC Pipe** - Polyvinyl Chloride Pipe - a common plastic pipe used for cold water distribution in both pressure (closed) or vented (DWV) applications. It is a material that softens and deforms when exposed to heat.

**Sealant** - A material that has the adhesive and cohesive properties to form a seal.

**Sealant Backing** - A compressible material placed in a joint before applying a sealant.

**Self-Leveling Sealant** - A compound that exhibits flow sufficient to seek gravitational leveling.

**Shelf Life** - The maximum time packaged materials can be stored under specified conditions and still meet the performance requirements specified.

**Shrinkage** - A decrease in length, area or volume.

**SRI –** Southwest Research Institute; a testing laboratory.

**Standard Time/Temperature Curve** - A graphical representation derived from prescribed time-temperature relationships and used to control burn test furnace temperatures with progressing time. (ASTM)

**Steel Sleeve** -A form used when pouring concrete to provide space for a penetrating item. Also may be used inside hollow construction walls to prevent firestopping materials from entering wall cavities unnecessarily.

**Structural Sealant** - A sealant capable of transferring dynamic or static ("live" and/or "dead") loads, or both, across joint members exposed to service environments typical for the structure involved.

**Substrate** - A material upon which films, treatments, adhesives, sealants, membranes, and coatings are applied.

**System Number** - A number assigned to a specific detail or series of similar details which are then indexed in numerical order in a reference book or directory.

**Tensile Strength** - Resistance of a material to a tensile force (stretch). The cohesive strength of a material expressed in psi.

**Tooling** - The act of compacting and contouring a sealant in a joint.

**Tooling Time** - The time interval after application of a one-component sealant or after mixing and application of multi-component sealant during which tooling is possible.

**T Rating** - A firestop shall be considered as meeting the requirements for a T rating when it remains in the opening during the fire test and hose stream test within the following limitations: The transmission of heat through the fires during the rating period shall not have been such as to raise the temperature of any thermocouple on the unexposed surface of the fires or on any penetrating item more than 325°F above its initial temperature. Also, the firestop shall have withstood the fire test for the rating period without permitting the passage of flame through openings, or the occurrence of flaming on any element of the unexposed side of the fires. During the hose stream test, the firestop shall not develop any opening that would permit a projection of water from the stream beyond the unexposed side. (ASTM E 814)

**Through Penetration** - Consists of three items: 1) wall or floor construction 2) penetrating item or absence thereof 3) the hole or void.

**UL** - Underwriters Laboratories Incorporated; an independent testing laboratory.

**Vented –** see Open System

**WHI** - Warnock Hersey International, Incorporated; an independent testing laboratory.

**Wire Mesh** - Galvanized steel hardware cloth used to support backing material in gypsum wallboard and hollow concrete block construction.

**Working ("pot") Life** - The time interval after opening a container of a single component sealant or after mixing the components of a multi-component sealant, during which application and tooling is possible.

# APPENDIX E

Water Quality Memorandum

ENSR
2 Technology Park Drive
Westford MA 01886
T 978-580-3000 F 978-589-3100 www.ensr.aecom.com

# Memorandum

Date: April 7, 2008

To: Heather Halsey/EDAW

From: Ishrat S. Chaudhuri, Ph.D., DABT/ENSR

Subject: PEX piping – potential for leaching and permeation of organic compounds

Distribution:

The purpose of this memorandum is to summarize the results of a review of peer-reviewed journal articles and other reports that have studied the issue of leaching of organic compounds from cross-linked polyethylene (PEX) piping and other types of piping materials used for potable water applications. The issue of permeation of organic compounds from the outside environment into the pipes is also evaluated. The conclusions reached from this review are provided.

## Introduction

This memorandum provides information to be used in the preparation of an Environmental Impact Report (EIR) for California statewide regulations that would allow the use of PEX piping in various cold and hot water plumbing (including potable water) applications. One of the concerns related to the use of PEX piping is contamination of drinking water either due to the direct leaching of organic compounds from the PEX materials, or due to the permeation of compounds present in the surrounding environment, such as pesticides and gasoline constituents, through the PEX piping into the drinking water. Various reports that contained information concerning this issue were reviewed, out of which ten reports were found to contain relevant information. The results and conclusions of these ten reports are summarized herein.

## Findings and conclusions

While the findings of the ten reports reviewed here are not precisely the same, the following can be offered as general findings.

1. PEX piping from various manufacturers have been tested by NSF International to determine whether compounds leaching from the piping are found at concentrations greater or less than the NSF reference criteria (USEPA and Health Canada drinking water standards and NSF derived risk-based levels). For some compounds California EPA has developed drinking water criteria (including standards that are based on taste and odor considerations; which are not considered in the NSF protocol) that are more stringent than those used by NSF. Therefore, some compounds could leach from PEX piping in concentrations exceeding California drinking water criteria, even though they may comply with USEPA criteria (or other criteria used by NSF). Based on a summary of testing data provided by NSF, out of the compounds identified as having California EPA drinking water criteria lower than the criteria used by NSF (benzene,

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2 Technology Park Drive
Westford MA 01886
T 978-589-3000 F 978-589-3100 www.ensr.aecom.com

t-butanol, MTBE, benzo(a)pyrene, cadmium and toluene), t-butanol and MTBE were identified as extractants exceeding California criteria. Approximately, 20% of all products tested between January 1, 2005 and December 31, 2007 had t-butanol concentrations greater than 200 ug/L (which is the detection limit; the California EPA notification level is 12 ug/L), and MTBE concentrations greater than 5 ug/L (which is the California EPA secondary MCL). Therefore, it is possible that t-butanol and MTBE could be present in water from NSF approved pipe that nonetheless would exceed California drinking water criteria.

2. In leaching tests, the type of PEX piping known as PEXa[1] in some cases has been reported to exhibit methyl-t-butyl ether (MTBE) and t-butanol at levels that are higher than the California EPA drinking water criteria for those chemicals. Any manufacturing method that uses peroxide can form these chemicals. In addition to PEXa, some forms of PEXb use peroxide. PEXc does not use chemicals for cross-linking, so these chemicals are unlikely to form with PEXc. These data suggest that, in some cases, pipes manufactured using PEXa and PEXb methods would not meet current California criteria for MTBE and t-butanol in potable water systems. Information from the manufacturers can be used to determine whether a specific type of PEX could result in leaching MTBE and t-butanol.

3. A study with PEXb found concentrations of the oxygenate compound, 2-ethoxy-2-methylpropane, commonly called ETBE (ethyl-t-butyl ether). Aqueous concentrations of ETBE in pipe leachate ranged from 23 ug/L to greater than 100 ug/L. People were able to smell ETBE at a concentration of 5 ug/L, therefore ETBE contributed to odor. ETBE does not have a drinking water criterion; however, MTBE, which is a structurally similar oxygenate has a secondary Maximum Contaminant Level (MCL) of 5 ug/L in California. This study reports that PEXb could have concentrations of a compound that could contribute to the taste and odor of drinking water, and potentially have adverse health implications.

4. PEX piping, similar to other plastic products, has been found to leach various chemicals, including degradation products of antioxidants (which are added to the PEX during the manufacturing process to resist chlorine degradation). Drinking water criteria have not been established for most of these chemicals. Hoffmann (2005; which is a non-peer reviewed analysis report submitted to the California Building Commission), states that these chemical concentrations are below those likely to cause adverse health effects.

5. There is evidence that use of PEX pipe should be restricted under certain soil conditions. A permeation study showed that polyethylene pipe was permeated by both TCE and gasoline (in both the soil and vapor phase) within several weeks. Chlordane was also tested for permeation, however, polyethylene pipe was not permeated by chlordane. The same study also tested iron and copper pipes, which were not permeated by any of the organic compounds in either the soil or the vapor environments. The study authors concluded that plastic pipe is susceptible to permeation by certain organic compounds, particularly solvents. Based on these

[1] There are three manufacturing processes for PEX, and the resulting products are commonly called PEXa (cross-linked by the peroxide method), PEXb (cross-linked by the silane method) and PEXc (cross-linked by irradiation). Results for the individual PEX products are discussed if the specific study differentiates between these products.

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results, the authors recommend that limitations are desirable in areas where the potential for soil contamination is high, such as a gasoline storage area. Theoretical calculations on permeation of termiticides indicated that these types of organic compounds would not permeate PEX piping (Hofffmann, 2005). Therefore, termiticides or pesticides are less likely to permeate PEX piping, and do not represent a concern. However, compounds such as gasoline and chlorinated solvents could present concerns for permeation.

## Issues of leaching and permeation

As stated in Tomboulian et al. (2004), organic polymeric materials such as PEX are potentially capable of leaching monomers, low molecular weight polymer units, and additives such as plasticizers, antioxidants, and application solvents. Compounds can enter the water due to leaching of additives or coatings used in the system material, leaching of original material itself, reaction of materials with chlorine or other direct additives, as well as biotransformation of leachates by fungi, algae, or bacteria in the system. Tomboulian et al. (2004) state that adverse taste and odor conditions may occur after a new piping installation or following maintenance, although typically the compound dissipates with time as the system is flushed.

Permeation is the movement of compounds present in the environment through pipe walls into the water. Lee (1985) discusses instances where petroleum constituents and other organic compounds have been found inside water in plastic pipes.

For both leaching and permeation, one key issue related to public health is whether the compounds present in the water are at concentrations that exceed health-based criteria. If the concentrations are lower than health-based criteria, then even though these compounds may be present in water their presence does not result in health impacts. For many compounds, health-based criteria have not been developed so it is not possible to say whether their presence in water could result in health impacts. This memorandum discusses comparisons with health-based criteria if such information is available. For some compounds, criteria based on aesthetic concerns (such as odor and taste) may be lower than health-based criteria. Criteria based on aesthetic concerns are also valid and important, and will be discussed if the information is available.

## Evaluation of leaching from PEX piping based on testing by NSF

<u>NSF testing protocol</u> - NSF International is a testing organization, which has tested PEX piping from various manufacturers and certified the piping to NSF/ANSI Standard 61, which is entitled Drinking Water System Components – Health Effects. This standard establishes the health effects requirements for the compound contaminants and impurities that are indirectly imparted to drinking water from products, components and materials used in drinking water systems (NSF, 2005). PEX piping is tested by exposing the piping to formulated exposure waters, and then analyzing the exposure waters for contaminants. Three separate formulated waters are used during the product exposure. Exposure waters of pH 5.0 and pH 10.0 are used because these waters aggressively extract metallic contaminants. Also, an exposure water of pH 8.0 is used for extracting organic contaminants. The piping samples containing water are heated to 140$^{o}$F (60$^{o}$C) for domestic hot water systems or 180$^{o}$F (82$^{o}$C) for commercial hot systems. The piping is conditioned by exposure to the formulated waters for 14 days with water being changed on 10 of those days. The water collected from the final 16-hour exposure period is then analyzed for a pre-determined suite of compounds, which include:

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- Volatile Organic Compounds (VOCs)
- Semi-volatile Organic Compounds (SVOCs)
- Phenolics
- Regulated metals including antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium and thallium
- Methanol
- Tertiary butyl alcohol (t-butanol)
- Methyl tertiary butyl ether (MTBE)
- Any other potential contaminants identified during the formulation review.

Drinking water criteria - Any detected compounds are compared against drinking water criteria. These criteria are described in NSF/ANSI Standard 61, Drinking Water System Components Health Effects (NSF, 2007). Annex D of NSF/ANSI Standard 61 contains “normative” drinking water criteria. The values in Annex D include:

- consensus USEPA and Health Canada drinking water criteria;
- criteria for non-regulated contaminants that have been developed according to the toxicity data requirements of Annex A [of NSF/ANSI Standard 61], and that have been externally peer-reviewed; and
- non-regulatory USEPA guidance values that have been reviewed and found to satisfy annex A toxicity data requirements.

Annex E of NSF/ANSI Standard 61 contains “informational” drinking water criteria, which have not undergone external peer review. The drinking water criteria in this annex are intended to be used as guidance in the determination of evaluation criteria for those compounds that do not have normative evaluation criteria established. NSF/ANSI Standard 61 states that the drinking water criteria do not include taste and odor considerations.

Comparison of NSF and California drinking water criteria - For some compounds, California EPA has developed drinking water criteria that may be more stringent than those used by NSF. Therefore, it is possible that some compounds could be present in water from NSF approved pipe that nonetheless would exceed California drinking water criteria.

The actual NSF testing results of PEX piping developed by different manufacturers were not available, since these results are considered proprietary information. A list of compounds that may leach from PEX piping and its components was compiled based on various reports (Table 1). The first set of compounds in Table 1 (Compounds in polyethylene, HDPE and PEX) are listed in Tomboulian et al. (2004) who compiled a list of compounds found by NSF to leach from various water distribution system components. Some of these compounds may be present in polyethylene or HDPE piping, and not in PEX piping, but the article does not differentiate between these materials. Tomboulian et al. (2004) also list compounds that have leached from polyurethane coatings and liners. These compounds are considered relevant because polyurethane coatings and liners are often used with PEX piping. In addition to the compounds listed in this paper, additional potentially leachable compounds were compiled from other sources, including Skjevrak et al. (2003).

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Table 1 also lists the hierarchy of NSF drinking water criteria for these compounds and drinking water values developed by California EPA if available. Many of the listed compounds do not have NSF or California criteria. The California EPA drinking water criteria include Public Health Goals (PHGs), MCLs and secondary MCLs (which are usually based on aesthetic considerations). Compounds that are shaded in Table 1 are those for which the California EPA drinking water criteria are lower than the criteria used by NSF. These compounds include benzene, t-butanol, MTBE, benzo(a)pyrene, cadmium and toluene. If these compounds were found to have leached from PEX piping components, it is important to determine whether the leached concentrations were lower than California EPA drinking water criteria.

<u>Testing results of PEX piping from one manufacturer</u> - The NSF testing results of Wirsbo's Aqua PEX tubing ½ inch (testing conducted on April, 2000) were made available (because of a litigation case) and evaluated for comparison against California EPA drinking water criteria. The testing results showed that a number of compounds were detected in the test water (2,2-dichloropropane, chloroform, MTBE, toluene, and t-butanol). The compounds, their detected concentrations, and the NSF and California criteria are shown in Table 2. As shown in Table 2, the detected concentration of MTBE (17 ug/L) is less than the NSF criterion of 50 ug/L, but higher than the California MCL of 13 ug/L and secondary MCL of 5 ug/L. The detected concentration of t-butanol (6900 ug/L) is less than the NSF criterion of 9000 ug/L, but higher than the California EPA Notification Level of 12 ug/L. The other detected compound concentrations are lower than the NSF or California criteria (no criteria were available for 2,2-dichloropropane). These testing results show that some types of PEX piping could leach compounds at concentrations higher than California criteria, even though these concentrations may be lower than USEPA or other NSF criteria.

<u>Summary of test data provided by NSF</u> – NSF provided a summary of test data for PEX piping tested between January 1, 2005 through December 31, 2007. Out of the compounds identified as having California EPA drinking water criteria lower than the criteria used by NSF (benzene, t-butanol, MTBE, benzo(a)pyrene, cadmium and toluene), t-butanol and MTBE were identified as extractants exceeding California criteria. Approximately, 20% of all products tested between January 1, 2005 and December 31, 2007 had t-butanol concentrations greater than 200 ug/L, which is the detection limit. It is noted that the detection limit of 200 ug/L is higher than the California EPA notification level of 12 ug/L for t-butanol. Therefore, a lower detection limit might indicate that a higher fraction than 20% could exceed the California EPA notification level for t-butanol. Approximately, 21% of all products had MTBE concentrations greater than 5 ug/L, which is California's secondary MCL for MTBE. Therefore, it is possible that t-butanol and MTBE could be present in water from NSF approved pipe that nonetheless would exceed California drinking water criteria.

## Evaluation of leaching from PEX piping based on literature studies

<u>Study discussing bisphenol A</u> - Tomboulian et al. (2004) listed various compounds found by NSF to leach from drinking water system components. The compounds potentially associated with PEX are listed in Table 1. Using this list as a starting point, the authors selected compounds that could potentially contribute to taste and odor (based on odor threshold), and/or cause toxicity. Under the heading 'Compounds leached from polyethylene, HDPE, PEX', the authors listed bisphenol A. Bispenol A is listed as having a 'medicinal' taste. Since polyethylene, HDPE and PEX were grouped together, it is not clear whether bisphenol A is specifically associated with PEX. As shown in Table 1, the NSF criterion for bisphenol A is 0.1 mg/L. Since California does not have a drinking water criterion for this compound, it is assumed that the NSF criterion would also be considered protective in California. If the

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NSF testing results showed bisphenol A to be at concentrations lower than the NSF criterion, then this compound would likely not be considered an issue in California.

Studies showing leaching of MTBE and t-butanol - Skjevrak et al. (2003) conducted a study evaluating odor and organic compounds migrating into drinking water from three types of plastic pipes - HDPE, PEX and PVC. In order to test the organoleptic properties of drinking water in contact with plastic pipes, the authors used a method that prescribes static contact between water and plastic pipe for three successive 72-hour periods. According to a Danish proposal for testing of plastic pipes for drinking water, no significant taste and odor of water should be observed in the third and final test. The organoleptic properties of water were assessed using a quantitative dilution method. Three dilutions of the test water samples were performed, and a threshold odor number (TON) was assessed at a scale from 0 to 5. TON values higher than 3 were assigned to water samples with significant odor in accordance with Norwegian drinking water regulations. Two PEX pipes were tested (designated pipe no. 1 and pipe no. 2). The authors did not specify whether the PEX pipes were PEXa, PEXb or PEXc. The main VOC in the test water from PEX pipes was MTBE. In test water from PEX pipe no. 1 the MTBE concentration was 47.6 ug/L in the first test and 33.5 ug/L in the third test. In test water from PEX pipe no. 2 the concentrations were considerably lower: 5.8 ug/L in the first test and 5.0 ug/L in the third test. It is noted that the MTBE concentrations detected in PEX pipe no. 1 meet the NSF criterion for MTBE of 50 ug/L, however these concentrations are higher than California EPA's PHG for MTBE of 13 ug/L, and the secondary MCL of 5 ug/L. t-butanol was also identified at the following concentrations: pipe no. 1 - 0.54 ug/L in the first test and 0.51 ug/L in the third test: pipe no. 2 – 1.1 ug/L in the first test and 1.2 ug/L in the third test. These concentrations are lower than both the NSF criterion for t-butanol of 9000 ug/L and the California EPA Notification Level of 12 ug/L. Several unidentified VOCs were also encountered in the test water samples. TON values were greater than 5 in all test samples of both PEX pipes, therefore the odors were considered to be significant. The authors state that MTBE is assumed to be one of the major contributors to the high values for TON. These results indicate that MTBE associated with PEX piping may be present in concentrations exceeding California EPA criteria in some cases. Since the study authors did not specify the type of PEX (a, b or c), it is not possible to conclude from this study whether MTBE is associated with a specific type of PEX. Odor from the PEX pipe was also found to be significant.

The company, Chemaxx, described a case of water contamination from PEX piping in newly constructed homes during 2001 (Chemaxx, 2005). T-butanol and MTBE were detected in the water. The levels of t-butanol spanned a broad range, but in homes where the water had been stagnant for a period of time the concentrations were as high as 10,000 ug/L. These values are higher than California EPA's Notification Level for t-butanol of 12 ug/L. The t-butanol was significantly more predominant than the MTBE. The authors note that the t-butanol and MTBE are breakdown products of t-butyl peroxide, which is used in one of the methods of cross-linking polyethylene piping (this method of cross-linking is used for PEXa). The authors also note that methods of cross-linking polyethylene piping that do not use t-butyl peroxide would not be expected to leach t-butanol and MTBE. They also note that these data pertain to PEX piping manufactured during 2001 or earlier and that current manufacturing processes may have different results. However, the authors state that some piping purchased in 2004 produced results reminiscent of the 2001 experience. These results indicate that in some cases piping made of PEXa could result in t-butanol and MTBE levels exceeding the California EPA drinking water criteria.

Study showing leaching of degradation products of antioxidants - Brocca et al. (2002) conducted a study of the diffusion of organic additives from four types of polyethylene piping materials into drinking water. PEX was one of the polyethylene materials. During the test, the inner surface of a pipe sample was

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brought into contact with test water for 7 days. At the end of the test period, the test water was removed and analyzed for organic compounds. Some of these organic compounds were attributed to by-products of phenolic additives used as antioxidants in pipeline production. The most common organic compounds found in PEX pipes were 3,5-di-*tert*-butyl-4-hydroxy benzaldehyde, 3,5-di-*tert*-butyl-4-hydroxy acetophenone, and cyclo hexa 1,4-dien, 1,5-bis (tert-butyl), 6-on, 4-(2-carboxy-ethylidene) (the last compound is tentatively identified.) The authors speculate that these compounds are alteration or degradation products of antioxidant agents used in polymer pipe production. Although these compounds were detected in tests, it is difficult to make any conclusions regarding potential health impacts of these compounds because no drinking water criteria have been developed for these compounds.

<u>Study showing leaching of ETBE</u> - Durand and Dietrich (2007) investigated silane cross-linked polyethylene (PEXb) using a migration-leaching protocol for evaluating taste and odor properties of materials prior to installation in distribution systems. Analysis of water samples after exposure to PEXb demonstrated the presence of a distinct odor categorized as ‘chemical/solvent like’. The ‘chemical/solvent like’ odors persisted even after multiple flushing periods. The oxygenate compound, 2-ethoxy-2-methylpropane, commonly called ETBE (ethyl-t-butyl ether), was identified as a contributor to the described odor from the PEX pipe. Aqueous concentrations of ETBE in pipe leachate ranged from a low of 23 ug/L to >100 ug/L. Panelists were able to smell ETBE at a concentration of 5 ug/L. ETBE does not have a drinking water criterion, however, MTBE, which is a structurally similar oxygenate has a secondary MCL of 5 ug/L in California. This study shows that PEXb could have concentrations of a compound that could contribute to the taste and odor of drinking water, and potentially have adverse health implications. The authors state that plastic pipe manufacturers must carefully consider the compatibility of the additives and other compounds used in pipe processing with various drinking water qualities.

<u>Study discussing leaching from other plastic products</u> - In an analysis report on PEX submitted to the California Building Commission conducted by Hoffmann (2005), he states that “detectable but minimal amounts of some chemical compounds can be leached or released from plastic materials into clean water. This is true for plastic water bottles, plastic baby bottles and for PEX and HDPE pipes. As noted above, typical release rates for prolonged exposures are most often in the range of ppt to ppb levels.” He also states that “typical polycarbonate bottles (Nalgene) released monomers, oligomers, UV stabilizers, antioxidants, degradation products and other additives.” Hoffmann states that “none of the leached levels of compounds approached regulated MCL limits or achieved dangerous levels for unregulated chemical compounds.” Therefore, Hoffmann contends that compounds potentially released from PEX are similar to compounds commonly released from plastic water bottles and baby bottles, and that the compound concentrations are below health criteria. However, Hoffmann does not provide actual concentrations of compounds, nor does he show the comparison of concentrations against health-based criteria. Therefore, his report has less scientific validity than the peer-reviewed journal articles.

## Evaluation of permeation of plastic piping of environmental chemicals

<u>Study discussing case reports of permeation</u> - Lee (1985) discussed several case histories of permeation of plastic pipes by organic compounds in the environment. The East Bay Municipal Utilities District in Oakland, California reported four instances of apparent petroleum distillate penetration of polybutylene water service lines. A case in Maryland was reported in which concentrations up to 5,500 ug/L of toluene were found in a water sample collected from a service line consisting of both polyethylene and polybutylene. The soil surrounding the service line was contaminated with gasoline as

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a result of a leaking underground storage tank. The Alabama Department of Environmental Management reported permeation of polybutylene service pipes with diesel fuel. In another incident, a private residence in Chattanooga, Tennessee reported that gasoline had leaked from the resident's car in the vicinity of a ¾ inch polyethylene service line and permeated the service line. A similar incident occurred in Darien, Connecticut where a resident complaint of gasoline odor in tap water resulted in sample analysis which showed benzene (>100 ug/L) and toluene (>50 ug/L) in the tap water. The odors were absent after flushing and when the homeowners' plumbing was in daily use. Samples collected after the system had not been used for 2 days contained approximately 16 ug/L benzene and a gasoline odor. The resident's 1 ¼ inch polyethylene service line was replaced with copper after it was determined that an abandoned underground gasoline storage tank on the resident's property had developed a leak and saturated the ground surrounding the line.

<u>Study discussing research on permeation by various organic compounds</u> - Lee (1985) also discussed a research investigation carried out by the American Water Works Service Company to determine the extent and nature of permeation of several different organic compounds through the types of service lines in use in the American Water Works system. Five pipe materials were used – iron, copper, polyethylene, polybutylene and polyvinyl chloride. The conditions of exposure were designed to simulate worst-case field conditions. One exposure tank involved exposure of the five piping materials to a vapor environment. The second exposure tank involved exposure of the five piping materials to a moist soil environment to which sufficient chemical was added so the pipe was above the saturated soil, but still within the moist capillary zone. Three organic compounds were investigated in each exposure tank – gasoline, trichloroethylene and chlordane. The pipes were in contact separately with the three organic compounds for a minimum 10-week exposure period. The pipes were unjointed ¾ inch lines filled with tap water. Water samples were analyzed at 4 intervals during the exposure period. The results were reported as follows:

1. Iron and copper pipes were not permeated by any of the organic compounds in either the soil or the vapor environments.

2. Polyethylene pipe was permeated by TCE within 1 week in both the soil and vapor exposure conditions. Gasoline permeation occurred within 1 day in the vapor and 3 weeks in the soil exposure. Chlordane did not permeate the polyethylene pipe in either the soil or vapor exposure condition.

3. Chlordane did not permeate the polybutylene and polyvinyl chloride pipes. Both types of pipes showed permeation of TCE and gasoline in both the soil or vapor exposure conditions.

The study authors concluded that plastic pipe is susceptible to permeation from certain organic compounds, particularly solvents. Based on these results, the authors recommend that limitations are desirable in areas where the potential for soil contamination is high, such as a gasoline storage area.

<u>Study discussing theoretical calculations of permeation</u> - In his analysis report (Hoffmann, 2005), Hoffmann conducted theoretical calculations on the length of time that would be required for an organic compound to permeate through the walls of PEX pipe. He estimated the characteristic time for diffusion of a compound through PEX pipe with a wall thickness of 0.5 cm (0.2 inch) and a diffusion coefficient of $1.0x10^{-12}$ $cm^2/s$ to be 8000 years. The diffusion coefficient used by Hoffmann appears to be representative of termiticides (he lists six representative termiticides – Bifenthrin, Chlorpyrifos, Cypermethrin, Fenvalerate, Imidachoprid and Permethrin). However, Hoffmann does not comment on the experimental results of Lee (1985) where the author found that polyethylene pipe was permeated by

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both TCE and gasoline (in both the soil and vapor phase) within several weeks. Lee (1985) found that chlordane did not permeate any of the pipes. Therefore, it is possible that Hoffmann's theoretical calculations apply only to organic compounds that are termiticides or pesticides (such as chlordane). However, his calculations may not apply to solvents, such as gasoline or TCE, which appear to have much faster permeation rates through plastic pipes based on the experimental results reported in Lee (1985).

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# Table 1
## Listing of Chemicals Potentially Present in PEX Tubing and Comparison Between NSF and California EPA Drinking Water Values

| | | NSF Values (Standard 61) (a) | | | | | | | | | | | California Values | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D1 | | D2 | | | D3 | | D4 | E1 | | E2 | | | | | |
| | | USEPA/ Health Canada MCL/MAC | USEPA/ Health Canada SPAC | NSF Peer-Reviewed TAC | NSF Peer-Reviewed SPAC | NSF Peer-Reviewed STEL | NSF based on USEPA guidance TAC | NSF based on USEPA guidance SPAC | TOE (g) | NSF International TAC | NSF International SPAC | TOE (g) | Listed in Prop. 65? (b) | PHG (c) | MCL (d) | Secondary MCL (d) | Notification Level (e) |
| Chemical | CAS | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | | mg/L | mg/L | mg/L | mg/L |
| *Chemicals in Polyethylene, HDPE or PEX (h):* | | | | | | | | | | | | | | | | | |
| acetophenone | 98-86-2 | | | 0.2 | 0.02 | 1 | | | | | | | | | | | |
| 2,4-bis(dimethylethyl)phenol | 96-76-4 | | | | | | | | | | | | | | | | |
| benzene | 71-43-2 | 0.005 | 0.0005 | | | | | | | | | | x | 0.00015 | 0.001 | | |
| benzothiazole | 95-16-9 | | | | | | | | x | | | | | | | | |
| bis-(dimethylethyl)benzene | | | | | | | | | | | | | | | | | |
| bisphenol A | 80-05-7 | | | | | | | | | 0.1 | 0.01 | | | | | | |
| BHT (methyl di(t-butyl)phenol) | 128-37-0 | | | | | | | | | | | | | | | | |
| carbon disulfide | 75-15-0 | 0.7 | 0.07 | | | | | | | | | | x | | | | |
| cyclohexadienedione | 106-51-4 | | | | | | | | | | | | | | | | |
| cyclo-hexanone | 108-94-1 | | | 30 | 3 | 40 | | | | | | | | | | | |
| cyclopentanone | 120-92-3 | | | | | | | | x | | | | | | | | |
| diazadiketo-cyclotetradecane | | | | | | | | | | | | | | | | | |
| dicyclopentylone | | | | | | | | | | | | | | | | | |
| dimethylhexanediol | 110-03-2 | | | | | | | | x | | | | | | | | |
| di-t-butyl oxaspirodecadienedione | | | | | | | | | | | | | | | | | |
| hydroxymethylethylphenyl ethanone | | | | | | | | | | | | | | | | | |
| isobutylene | 115-11-7 | | | | | | | | x | | | | | | | | |
| methanol | 67-56-1 | | | 20 | 2 | 20 | | | | | | | | | | | |
| methyl butenal | 1115-11-3 | | | | | | | | x | | | | | | | | |
| methyl di-t-butyl hydroxyphenyl proprionate | 6386-38-5 | | | 0.02 | 0.002 | 0.1 | | | | | | | | | | | |
| methyl (di-t-butylhydroxy-phenyl)propionate | | | | | | | | | | | | | | | | | |
| methylbutenol | 115-18-4 | | | | | | | | | | | | | | | | |
| nonylcyclopropane | | | | | | | | | | | | | | | | | |
| phenolics | | | | | | | | | | | | | | | | | |
| phenylenebis-ethanone | | | | | | | | | | | | | | | | | |
| propenyl-oxymethyl oxirane | | | | | | | | | | | | | | | | | |
| t-butanol | 75-65-0 | | | 9 | 0.9 | 40 | | | | | | | | | | | 0.012 |
| tetrahydrofuran | 109-99-9 | | | | | | | | | 1 | 0.37 | | | | | | |
| trichloroethylene | 79-01-6 | 0.005 | 0.0005 | | | | | | | | | | x | 0.0008 | 0.005 | | |
| | | | | | | | | | | | | | | | | | |
| *Polyurethane coatings and liners (h):* | | | | | | | | | | | | | | | | | |
| 1,4-butanediol | 110-63-4 | | | | | | | | | | | | | | | | |
| 4,4-methylenedianiline | 101-77-9 | | | | | | | | | 0.001 | 0.0001 | | x | | | | |
| bis(2-ethylhexyl)phthalate | 117-81-7 | | 0.0006 | 0.0006 | | | | | | | | | x | 0.012 | 0.004 | | |
| bisphenol A diglycidyl ether | 1675-54-3 | | | 1 | 0.1 | 5 | | | | | | | | | | | |
| butyl benzyl phthalate | 85-68-7 | | | | | | 1 | 0.1 | | | | | x | | | | |
| diphenyl(ethyl)phosphine oxide | | | | | | | | | | | | | | | | | |
| di-t-butyl methoxyphenol | | | | | | | | | | | | | | | | | |
| ethylhexanol | 104-76-7 | | | | | | | | | 0.05 | 0.05 | | | | | | |
| tetramethyl peperidinone | 826-36-8 | | | | | | | | | | | x | | | | | |
| toluene diamine | | | | | | | | | | | | | x | | | | |
| | | | | | | | | | | | | | | | | | |
| *Additional Chemicals (i):* | | | | | | | | | | | | | | | | | |
| methyl tert butyl ether (MTBE) | 1634-04-4 | | | | | | 0.05 (f) | | | | | | | 0.013 | 0.013 | 0.005 | |
| phthalates | | | | | | | | | | | | | | | | | |
| carbon black | 1333-86-4 | | | | | | | | | | | | x | | | | |
| benzo(a)pyrene | 50-32-8 | 0.0002 | 0.00002 | | | | | | | | | | x | 0.000004 | 0.002 | | |
| mercury | 7439-97-6 | 0.002 | 0.0002 | | | | | | | | | | x | 0.0012 | 0.002 | | |
| cadmium | 7440-43-9 | 0.005 | 0.0005 | | | | | | | | | | x | 0.00004 | 0.005 | | |
| PAHs | | | | | | | | | | | | | | | | | |
| *Additional Chemicals (j):* | | | | | | | | | | | | | | | | | |
| 4-butoxyphenol | 122-94-1 | | | | | | | | | | | | | | | | |
| 5-methyl-2-hexanone (MIAK) | 110-12-3 | | | 0.06 | 0.006 | 0.8 | | | | | | | | | | | |
| *Additional Chemicals (k):* | | | | | | | | | | | | | | | | | |
| chloroform | 67-66-3 | 0.08 | 0.008 | | | | | | | | | | x | | | | |
| toluene | 108-88-3 | 1 | 0.1 | | | | | | | | | | x | 0.15 | 0.15 | | |

Notes:
Shaded chemicals represent those for which NSF values are higher than California drinking water values.
PEX - Cross-linked polyethylene.

| | | NSF Values (Standard 61) (a) | | | | | | | | | | | California Values | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D1 | | D2 | | | D3 | | D4 | E1 | | E2 | | | | | |
| | | USEPA/ Health Canada MCL/MAC | USEPA/ Health Canada SPAC | NSF Peer-Reviewed TAC | NSF Peer-Reviewed SPAC | NSF Peer-Reviewed STEL | NSF based on USEPA guidance TAC | NSF based on USEPA guidance SPAC | TOE (g) | NSF International TAC | NSF International SPAC | TOE (g) | Listed in Prop. 65? (b) | PHG (c) | MCL (d) | Secondary MCL (d) | Notification Level (e) |
| Chemical | CAS | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | | mg/L | mg/L | mg/L | mg/L |

NSF - NSF International, Inc.
ANS - American National Standard.
MCL - Maximum Contaminant Level.
MAC - Maximum Acceptable Concentration.
SPAC - Single Product Allowable Concentration.
TAC - Total Allowable Concentration.
STEL - Short-term Exposure Level.
TOE - Threshold of Evaluation.
PHG - Public Health Goal.
(a) NSF and ANS, 2007a. Drinking water systems components Health effects. NSF/ANSI 61 - 2007a.
(b) OEHHA, 2007. Chemicals Known to the State to Cause Cancer or Reproductive Toxicity. Safe Drinking Water and Toxic Enforcement Act of 1986. [http://oehha.ca.gov/prop65/prop65_list/Newlist.html]
(c) OEHHA, 2008. Public Health Goals for Water. [http://oehha.ca.gov/water/phg/allphgs.html]
(d) CDPH, 2008. Table 64444-A, Table 64431-A and Table 64449-A. Title 22 California Code of Regulations California Safe Drinking Water Act & Related Laws and Regulations. [http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Lawbook.aspx].
(e) OEHHA, 1999. Water Notification Levels. [http://www.oehha.ca.gov/water/pals/index.html].
(f) This NSF value was not found in NSF (2007a), but has been referenced by other sources.
(g) Chemicals that did not meet the minimum data requirements to develop chemical specific concentrations were evaluated under the threshold of evaluation (TOE). As defined by Section A.7.1 of NSF Standard 61 (NSF, 2007), a risk assessment is not required for a substance if the normalized concentration is less than or equal to the following concentrations: 3 ug/L (chronic exposure, static normalization conditions), 0.3 ug/L (chronic exposure, flowing normalized conditions), and 10 ug/L (short-term exposure, initial laboratory concentration).
(h) List of chemicals found by NSF to leach from system components (Tomboulian et al., 2004). Many of these chemicals may not be found in PEX.
(i) Various sources.
(j) Testing on PEX pipes conducted by Skjevrak et al. (2003).
(k) Detected chemicals during NSF testing of Wirsbo Aqua PEX testing, April 2000. Only those with at least one available NSF value or California standard are listed.

**Table 2**
**Results of NSF Testing of Wirsbo Aqua PEX testing (a), and Comparison Against Health-Based Criteria**

| Chemical (b) | CAS | Detected Concentration mg/L | NSF Values (Standard 61) (c) USEPA / Health Canada MCL/MAC mg/L | USEPA / Health Canada SPAC mg/L | NSF Peer-Reviewed TAC mg/L | NSF Peer-Reviewed SPAC mg/L | NSF Peer-Reviewed STEL mg/L | NSF based on USEPA guidance TAC mg/L | California Values Listed in Prop. 65? (d) | PHG (e) mg/L | MCL (f) mg/L | Secondary MCL (f) mg/L | Notification Level (g) mg/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| 2,2-Dichloropropane | 594-20-7 | 0.0017 | NA | NA | NA | NA | NA | NA | | NA | NA | NA | NA |
| Chloroform | 67-66-3 | 0.0062 | 0.08 | 0.008 | NA | NA | NA | NA | x | NA | NA | NA | NA |
| MTBE | 1634-04-4 | 0.017 | 0.05 (h) | | | | | | | 0.013 | 0.013 | 0.005 | NA |
| Toluene | 108-88-3 | 0.0012 | 1 | 0.1 | NA | NA | NA | NA | x | 0.15 | 0.15 | NA | NA |
| 2-methyl-2-propanol (t-butanol) | 75-65-0 | 6.9 | NA | NA | 9 | 0.9 | 40 | NA | | NA | NA | NA | 0.012 |
| | | | | | | | | | | | | | |

Notes:
NA - Not available.
NSF - NSF International, Inc.
ANS - American National Standard.
PEX - Cross-linked polyethylene.
(a) Testing conducted in April, 2000.
(b) Detected Chemicals.
(c) NSF and ANS, 2007a. Drinking water systems components Health effects. NSF/ANSI 61 - 2007a.
(d) OEHHA, 2007. Chemicals Known to the State to Cause Cancer or Reproductive Toxicity. Safe Drinking Water and Toxic Enforcement Act of 1986. [http://oehha.ca.gov/prop65/prop65_list/Newlist.html]
(e) OEHHA, 2008. Public Health Goals for Water. [http://oehha.ca.gov/water/phg/allphgs.html]
(f) CDPH, 2008. Table 64444-A and Table 64431-A. Title 22 California Code of Regulations California Safe Drinking Water Act & Related Laws and Regulations. [http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Lawbook.aspx]
(g) OEHHA, 1999. Water Notification Levels. [http://www.oehha.ca.gov/water/pals/index.html].
(h) This NSF value was not found in NSF (2007a), but has been referenced by other sources.

# APPENDIX F

NSF Over-Time Testing Reports

**NSF International**

Plastic Pipe and Fittings Association
800 Roosevelt Road
Building C, Suite 312
Glen Ellyn, Illinois 60137

April 18th, 2008

To whom it may concern,

This document has been prepared by NSF International at your request. It includes a summary of historical overtime test data for t-butanol as an extractant from cross-linked polyethylene pipe and tubing which have been tested at NSF International to the requirements of NSF/ANSI Standard 61. T-butanol is considered to be a break down product of t-butyl peroxide, which is one of the catalysts that can be used for the cross-linking of polyethylene. It has been requested of NSF International to determine at what point in time during the exposure process would t-butanol reach the State of California's pass/fail action level of 13 parts per billion (ppb).

When testing, the samples are conditioned for 16 days prior to the critical day water collection on day 17. For overtime exposures the water is also collected and analyzed on days 1, 2, 3, 8, 10 and 21. Analyzing water samples from days throughout the exposure is necessary for running the regression analysis. A total of five overtimes were identified and used to summarize the decay pattern of t-butanol. Three different regression models (Power, Exponential and Linear) were applied to the data. From these analyses it was determined that the Exponential model was the most appropriate model to use based upon the coefficient of determination ($r^2$ value) for each of the five independently run samples. Table 1 summarizes the range of t-butanol levels, by day of exposure, for all 5 samples. Table 2 provides a summary of the overtime testing results for t-butanol.

**Table 1. Range of t-butanol levels, by day of exposure, for all 5 samples.**

| Day of Exposure | T-butanol (ppb) |
|---|---|
| *Day 1* | 2,000 – 39,000 |
| *Day 2* | 1,400 – 35,800 |
| *Day 3* | 1,100 – 29,500 |
| *Day 8* | 900 – 26,000 |
| *Day 10* | 640 – 23,700 |
| *Day 17* | 310 – 13,200 |
| *Day 21* | 600 – 11,000 |

**Table 2. Results of the regression analysis performed on all 5 individual samples.**

| Sample | $r^2$ value (Model) | Extrapolated lab day 107 (Day 90) level for t-butanol | Predicted day that t-butanol would reach 12 ppb |
|---|---|---|---|
| *Sample 1* | 0.978 (Exponential) | 65.5 ppb | Day 136 |
| *Sample 2* | 0.965 (Exponential) | 15.8 ppb | Day 111 |
| *Sample 3* | 0.952 (Exponential) | 0.38 ppb | Day 73 |
| *Sample 4* | 0.908 (Exponential) | 36.5 ppb | Day 125 |
| *Sample 5* | 0.955 (Exponential)* | 0.03 ppb | Day 48 |

* Day 21 was removed.

These extraction results vary by the amount of peroxide used, the age of the tubing, and the variability that can be introduced during the manufacture of this material. Based upon these 5 test results it is indicated that t-butanol will decay to levels below 13 ppb in as few as 48 days to a maximum of 136 days. For sample 5 the day 21 value was twice the day 17 value. This sharp increase on the final day was considered an outlier and removed. These analyses are based upon 5 independent 21 day overtime tests that suggest the Exponential model most likely fits the real decay pattern of t-butanol. However, we currently do not have any actual long term exposure data to support which model is the most appropriate.

If you have further questions concerning this subject, please do not hesitate to contact me.

Sincerely,

**Clifton J. McLellan**
Director of Toxicology Services
NSF International

Plastic Pipe and Fittings Association
800 Roosevelt Road
Building C, Suite 312
Glen Ellyn, Illinois 60137

May 2nd, 2008

To whom it may concern,

This document has been prepared by NSF International at your request. It includes a summary of ongoing overtime testing for methyl-tert-butyl ether (MTBE), up to day 21, as an extractant from cross-linked polyethylene pipe and tubing which have been tested at NSF International to the requirements of NSF/ANSI Standard 61. MTBE is considered a break down product of t-butyl peroxide, which is one of the catalysts that can be used for the cross-linking of polyethylene. It has been requested of NSF International to run overtime testing on 10 separate samples, from different PEX manufacturers, to determine actual Day 90 levels for MTBE.

When testing, the samples are conditioned for 16 days prior to the critical day water collection on day 17. For overtime exposures the water is also collected and analyzed on days 1, 2, 3, 8, 10, 21, 36, 49 and 107. Analyzing water samples from days throughout the exposure is necessary for running the regression analysis. A total of 9 overtimes were identified and used to summarize the decay pattern of MTBE. Three different regression models (Power, Exponential and Linear) were applied to the data. From these analyses it was determined that the Power model was the most appropriate model to use based upon the coefficient of determination ($r^2$ value) for each of the 9 independently run samples. Table 1 summarizes the range of MTBE levels, by day of exposure, for all 9samples. Table 2 provides a summary of the overtime testing results for MTBE.

**Table 1. Range of MTBE levels, by day of exposure, for all 9 samples.**

| Day of Exposure | MTBE (ppb) |
|---|---|
| *Day 1* | 1.8 – 290 |
| *Day 2* | 1.5 – 150 |
| *Day 3* | 1.4 – 150 |
| *Day 8* | 0.55 – 76 |
| *Day 10* | 0.75 – 87 |
| *Day 17* | 0.55 – 58 |
| *Day 21* | 0.55 - 49 |

**Table 2. Results of the regression analysis performed on all 9 MTBE samples.**

| Sample | $r^2$ value (Model) | Extrapolated lab day 107 (Day 90) level for MTBE | Predicted day that MTBE would reach 11 ppb |
|---|---|---|---|
| *Sample 1 J-00056620* | 0.843 (Power) | 12 | 181 |
| *Sample 2 J-00056621* | 0.879 (Power) | 15 | 236 |
| *Sample 3 J-00057146* | 0.873 (Power) | 0.26 | 1* |
| *Sample 5 J-00057148* | 0.983 (Power) | 25 | 679 |
| *Sample 6 J-00057149* | 0.924 (Power) | 19 | 286 |
| *Sample 7 J-00057150* | 0.952 (Power) | 0.17 | 1* |
| *Sample 8 J-00057151* | 0.832 (Power) | 0.48 | 1* |
| *Sample 9 J-00057152* | 0.947 (Power) | 0.25 | 1* |
| *Sample 10 J-00057153* | 0.940 (Power) | 0.21 | 1* |

*** Levels for MTBE were below 11 ppb by day 1.**

These extraction results vary by the amount of peroxide used, the age of the tubing, and the variability that can be introduced during the manufacture of this material. Based upon these 9 test results it was determined that MTBE would decay to levels below 12 ppb in as few as 1 day to a maximum of 679 days. These results are preliminary and the model chosen may not be the most suitable model to extrapolate a Day 90 level.

If you have further questions concerning this subject, please do not hesitate to contact me.

Sincerely,

**Clifton J. McLellan**
Director of Toxicology Services
NSF International